

Phase 1  
Draft Report

# EXECUTIVE SUMMARY

AUGUST 2021



## Executive Summary

### Converting Route 1 to a Multimodal, Urban Boulevard

U.S. Route 1/Richmond Highway (Route 1) between 12th Street S and 20th Street S in the Crystal City area of Arlington County is currently an elevated freeway that forms a barrier between destinations to the east and west of Route 1. While Crystal City and Pentagon City are evolving from auto-centric developments to higher-density, urban places that people can access by a variety of modes—walking, biking, taking transit, or driving—there is a desire on the part of many stakeholders to remove this half-mile-long segment of urban freeway, embrace Route 1 as a city street with storefronts and building entrances, and knit together the urban fabric of Crystal City, as part of the larger National Landing area.

With Arlington County's successful implementation of land use plans and multimodal transportation improvements, Crystal City and Pentagon City have attracted major new development projects, including Amazon's second headquarters (HQ2). The November 2018 memorandum of understanding (MOU) between Amazon and the Commonwealth of Virginia includes a commitment by the Commonwealth "to expeditiously evaluate and implement opportunities to improve safety, accessibility, and the pedestrian experience crossing" Route 1.

With this commitment, the Virginia Department of Transportation (VDOT) is taking the lead to examine the feasibility of converting Route 1 to an at-grade or elevated urban boulevard (or improving the existing elevated roadway) from 12th Street S to 23rd Street S. VDOT will then develop appropriate multimodal solutions for Route 1 to meet the community's transportation needs with the coming of Amazon and other related development.



Amazon HQ2 Building Concept (Source: Amazon.com)

Freeway Segment of Route 1 in Crystal City and Interchange with 15th Street S

## Guided by the Study Purpose and Goals and a Vision for National Landing

The purpose of this study is to improve multimodal connectivity and accommodations along and across Route 1 in Crystal City to meet the changing transportation needs of this growing urban activity center.

The goals of this study and a future Route 1 multimodal improvements project are as follows:

- **Safety** – improve multimodal safety for pedestrians, bicyclists, micro mobility modes, transit, and vehicles along and across Route 1
- **Multimodal Accessibility and Accommodation** – increase multimodal accessibility and accommodation along and across Route 1—pedestrians, bicycles, transit, vehicles (and any other mode)
- **Transit Effectiveness** – make transit more accessible, reliable, and convenient
- **Vehicular Operations** – maintain an appropriate level of vehicular operation and accommodation along Route 1 and on intersecting streets—15th, 18th, 20th, and 23rd Streets S
- **Environmental** – preserve, protect, or enhance the built, natural, visual, and social environments
- **Urban Fabric** – integrate Route 1 with the urban fabric of Crystal City and Pentagon City as a multimodal urban boulevard design consistent with context of the surrounding existing and future built environment

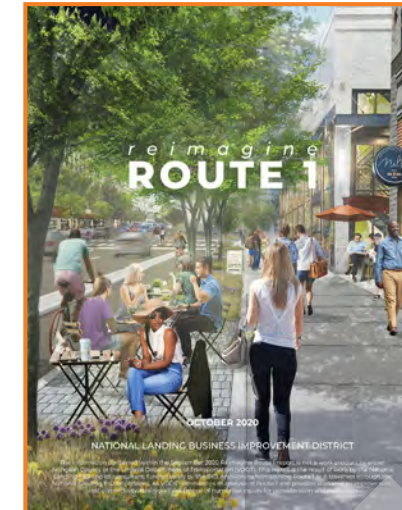
These goals provided the basis for the development of measures of effectiveness (MOEs), which were used to evaluate possible Route 1 urban boulevard at-grade and grade-separated scenarios, as well as possible improvements to the existing freeway.



People on Scooters Crossing Route 1 at 20th Street S



Route 1 in Crystal City



To achieve safety, multimodal connectivity, and the other goals of this project, this study builds upon urban design guides, the national trend of removing urban freeways and reconnecting neighborhoods, and the following local policies and planning documents:

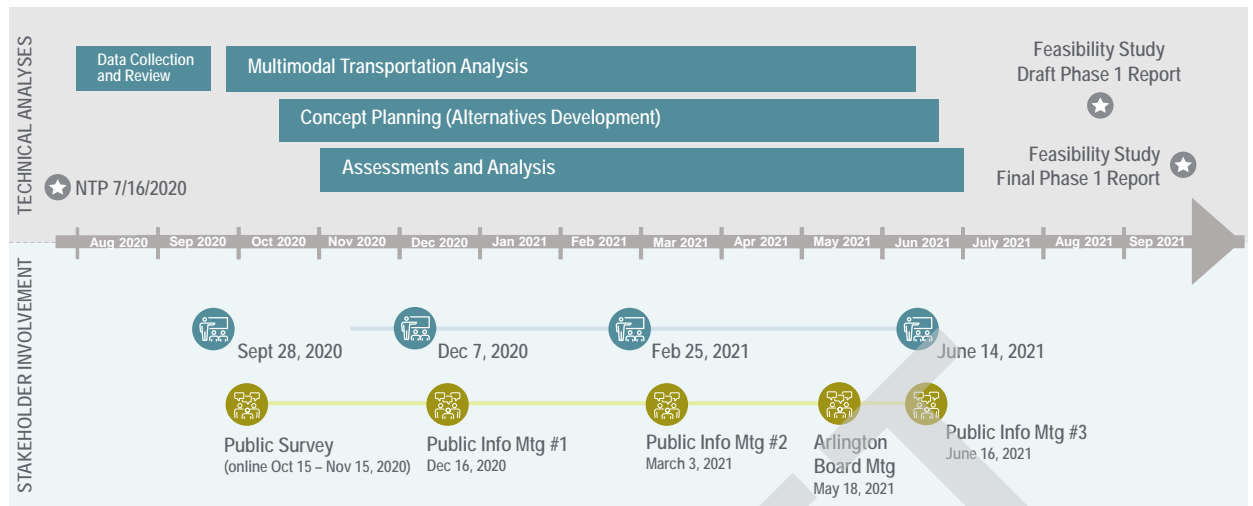
- The 2010 **Crystal City Sector Plan** lays out the community's vision to transform Crystal City into a more inviting, lively, and walkable community. It includes the transformation of U.S. 1 into an urban boulevard linking Crystal City's east and west neighborhoods.
- The 2020 National Landing Business Improvement District's (BID's) **"Reimagine Route 1"** calls for transforming Route 1 "into a multi-modal, pedestrian-friendly, and urban-oriented boulevard that unifies the area into a truly walkable, connected, urban downtown."
- The 2019 **Livability 22202 Action Plan** states that one of its key priorities is to "Design and implement better and safer connections across Route 1."

Together, these documents, as well as the input of stakeholders and the public during this study, provide a vision for National Landing.

## Stepping Through a Deliberate Study Process

This Phase 1 study took steps to provide sufficient information to make the best decision on a future project for Route 1 to meet the community's vision and National Landing's transportation needs. To this end, the VDOT study team stepped through a series of technical analyses—in coordination with stakeholder involvement, and within a study area that included Route 1 and its interfaces with 15th Street S, 18th Street S, and 20th Street S—to examine the feasibility of three possible future Route 1 configurations:

- Route 1 urban boulevard with at-grade intersections at 15th Street S and 18th Street S
- Route 1 urban boulevard with a revamped interchange at 15th Street S and a new bridge over 18th Street S, mimicking the Sector Plan concept
- Modified existing grade-separated Route 1 with lower-cost safety enhancements



Study Tasks and Schedule (Phase I)

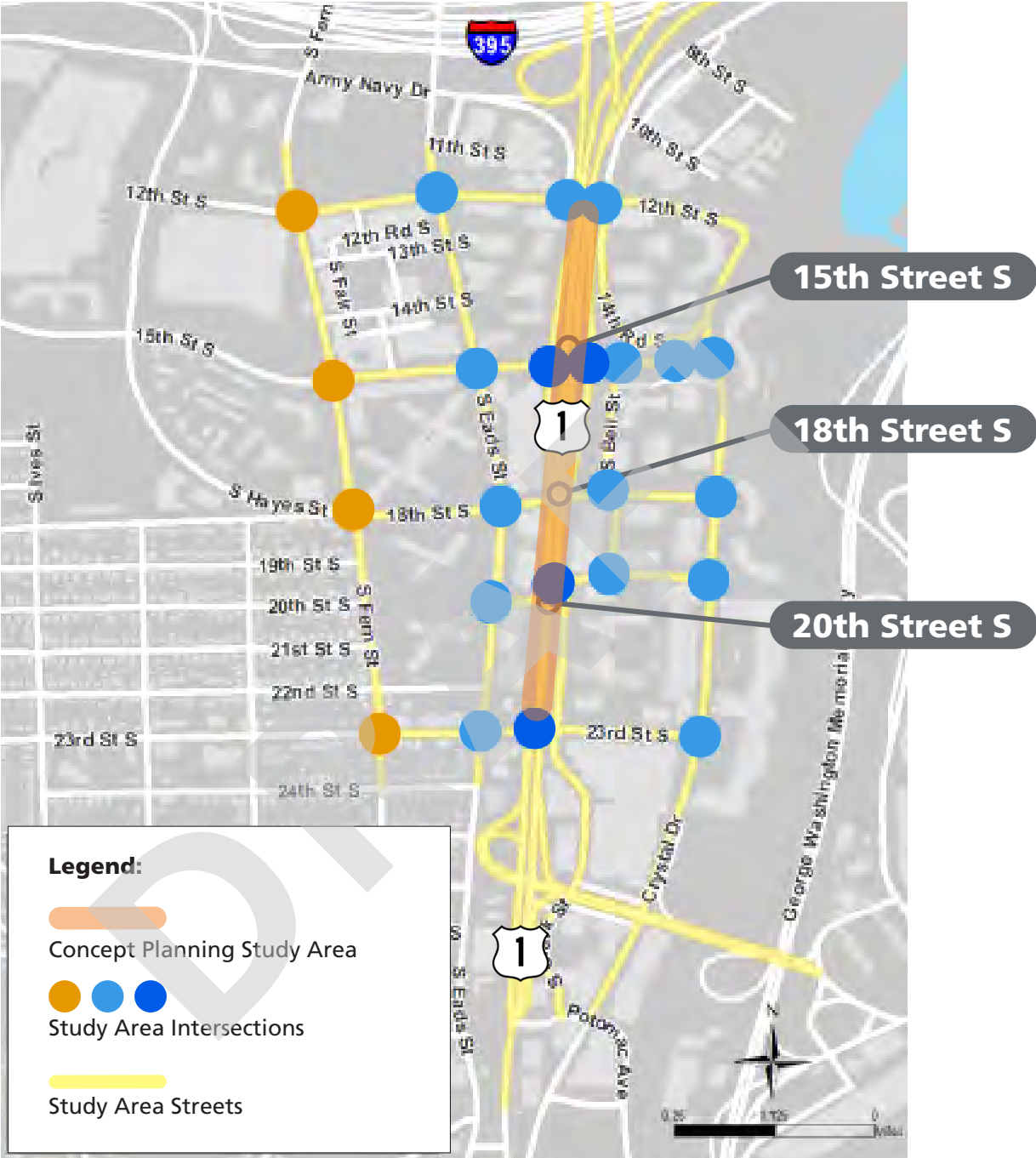
Referring to the schedule shown above, this study included a concept development and screening process that was integrated with the engagement of a project Task Force and the public. Existing and projected future No-Build conditions were analyzed through the collection of geometric, traffic, and safety data, as well as information on planned land use and programmed transportation improvements in the area. These analyses led to the development and analyses of multiple concepts for at-grade urban boulevard concepts and refinement of those concepts.

It should be noted that the focus of this concept development process was primarily on the at-grade configuration because the grade-separated concept had been studied extensively during the Sector Plan process.

Ultimately, several concepts were carried forward for more detailed feasibility analyses, which included an examination of the following aspects of a potential Route 1 project:

- **Constructability, including maintaining access during construction for pedestrians, bicycles, transit, and vehicles**
- **Stormwater management and low-impact development approaches**
- **Developable land resulting from each of the possible Route 1 configurations**
- **Planning-level cost estimates**
- **Resulting multimodal transportation operations and safety**

This Phase 1 study used existing available data sources to facilitate the transportation analyses across all modes within the Route 1 corridor—pedestrians, bicycles, transit, and vehicles. The study areas for the multimodal analyses and development of concepts are shown in the map on page ES-9.



### Multimodal Analysis Study Area and Concept Planning Study Area

Procedures and assumptions for this study followed an analysis methodology and design criteria which was agreed upon with Arlington County's Transportation Division, in coordination with Arlington's ongoing separate Pentagon City Planning Study. This VDOT study made use of existing travel demand and operations analysis models and of previously collected traffic data from Arlington County to have consistency between VDOT's and Arlington County's studies.

## Involving Stakeholders in the Process

Stakeholder feedback informed the study process. Engaging stakeholders through a Route 1 Task Force—and using surveys, public meetings, comment forms, and other means of communication—allowed VDOT to receive meaningful feedback regarding the stakeholder priorities and concerns throughout the Phase 1 study period of fall 2020 through fall 2021.



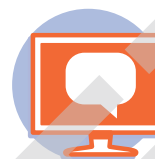
**160** emails and letters received



**1,246** survey responses



**196** questions addressed during public meetings



**97** online comments received



**12** emails sent to a subscriber base that grew by **131%** throughout the study

## Route 1 Task Force

Stakeholder engagement first involved the formation of a Route 1 Task Force, which was intended to build upon the successes of the Crystal City Task Force that guided the development of the 2010 Crystal City Sector Plan. Representatives from public agencies, businesses, and neighborhood groups were invited to participate in meaningful discussions and help guide the development of this study. Route 1 Task Force members provided feedback on public involvement strategies, the study process, and technical findings.

The Route 1 Task Force included members from the following organizations:

- Crystal City Citizens Review Council
- National Landing BID
- Arlington Ridge Civic Association
- Aurora Highlands Civic Association
- Crystal City Civic Association
- Arlington County Planning Commission
- Arlington County Transportation Commission
- Arlington County Bicycle Advisory Committee
- Arlington County Pedestrian Advisory Committee
- Arlington County Transit Advisory Committee
- Arlington County Transportation Division
- City of Alexandria
- Virginia Railway Express (VRE)
- Washington Metropolitan Area Transit Authority (WMATA)
- Metropolitan Washington Airports Authority (MWAA)
- National Park Service (NPS)
- VDOT

Task Force members represented their organizations, provided feedback to VDOT on study findings and recommendations, and advocated for input to the study from stakeholders and the general public.

## Public Engagement

Three rounds of public outreach were conducted to solicit input and feedback from the public and stakeholders. Each round had a specific objective that informed the technical study processes.

### Round 1

- MetroQuest Survey (mid-October to mid-November 2020):** Outreach effort to engage the public and encourage participation in an online survey to gauge initial community preferences and priorities
- Virtual Public Information Meeting (PIM) #1 (December 16, 2020):** Virtual public meeting to engage the public and stakeholders and review results of the online survey and the analysis of existing mobility and safety conditions in the corridor

### Round 3

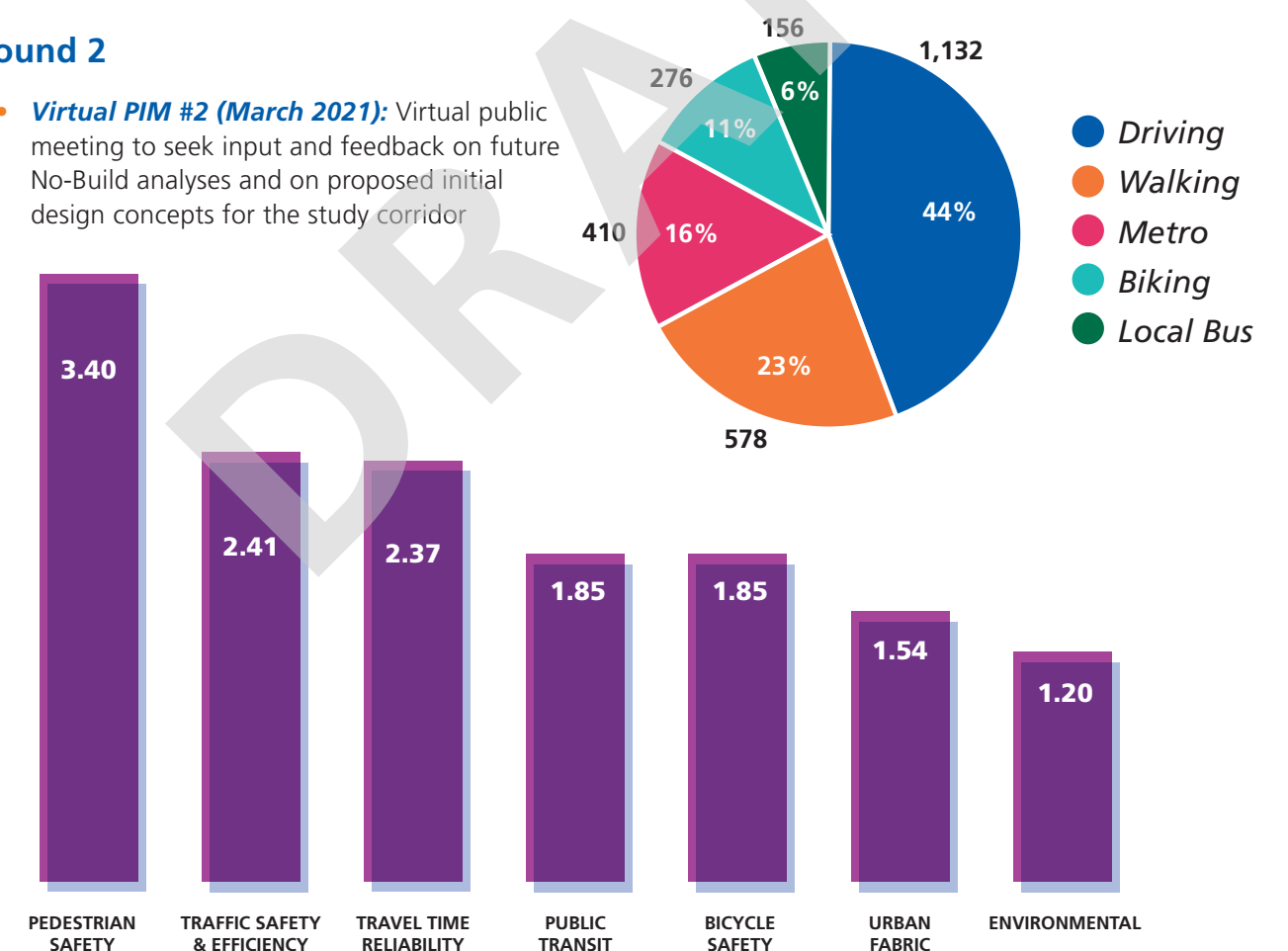
- Virtual PIM #3 (June 2021):** Virtual public meeting to seek feedback from public and stakeholders on study analysis results and interim Phase 1 recommendations.

Sample MetroQuest Survey feedback is shown below.

### How do you currently use Route 1?

### Round 2

- Virtual PIM #2 (March 2021):** Virtual public meeting to seek input and feedback on future No-Build analyses and on proposed initial design concepts for the study corridor



Design Priorities for Survey Respondents (1-5 Scale)

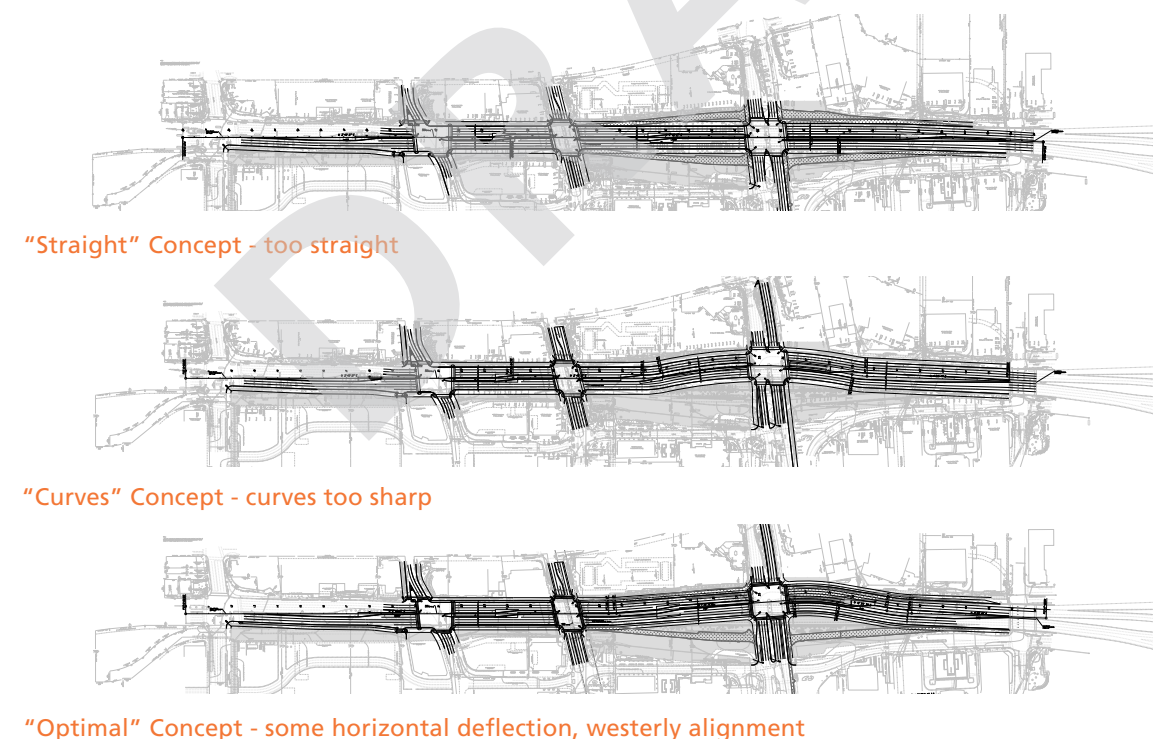
## Developing Route 1 Multimodal Improvement Concepts

The Route 1 study team considered existing conditions, planned future conditions, and stakeholder input to develop a range of possible concepts for a Route 1 multimodal, at-grade urban boulevard as a comparison to the grade-separated concept of the Sector Plan.

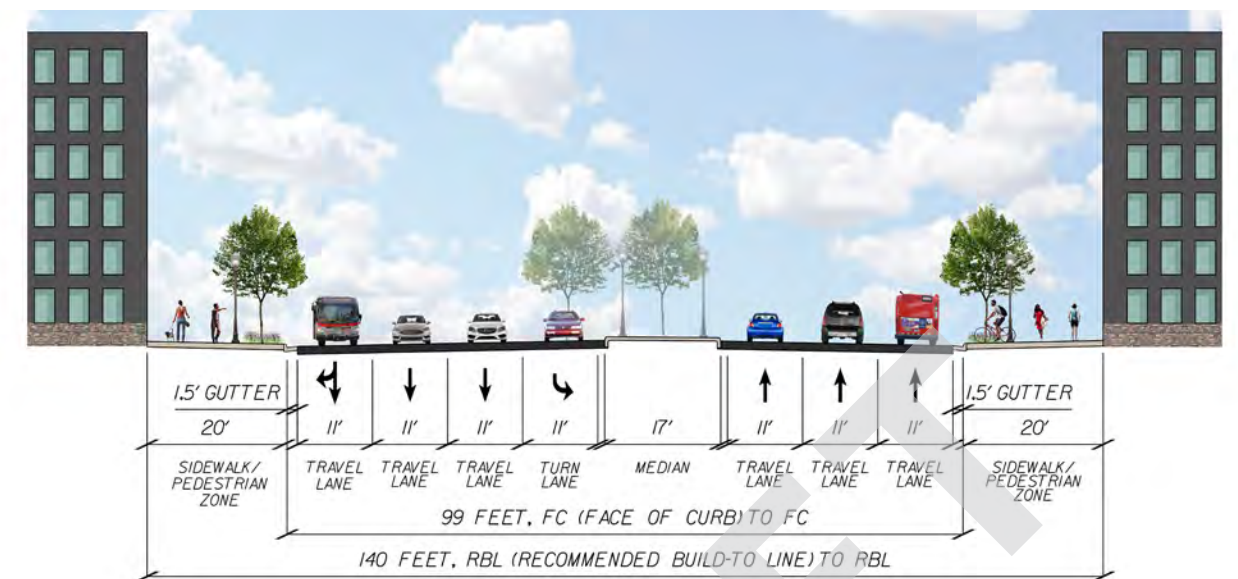
The concept development considered the goals of this study, the need for balancing competing needs in the street space, and the various design elements. The at-grade concepts were developed, screened, and refined with the intent to identify enhanced multimodal connectivity and accommodations across and along Route 1 in Crystal City to meet the changing transportation needs of this growing urban activity center.

The study team examined various at-grade alignments, cross sections, and intersection lane configurations for the initial concepts. When initially screening the at-grade scenarios, three alternative alignments were considered—one as a straight line following the existing Route 1 centerline, a second alignment including curvature to the west using the sharpest radii allowed per the VDOT [Road Design Manual](#), and a third alignment which curves more gently to the west. The third more gentle curving scenario was selected as the preferred alternative for two reasons—first, the horizontal curvature would assist in reducing speeds, especially for southbound traffic coming from I-395, and second, the horizontal curvature would not be so extreme as to misalign with driver expectations and create safety concerns.

These various alignments are shown below, with initial cross sections shown on the right.



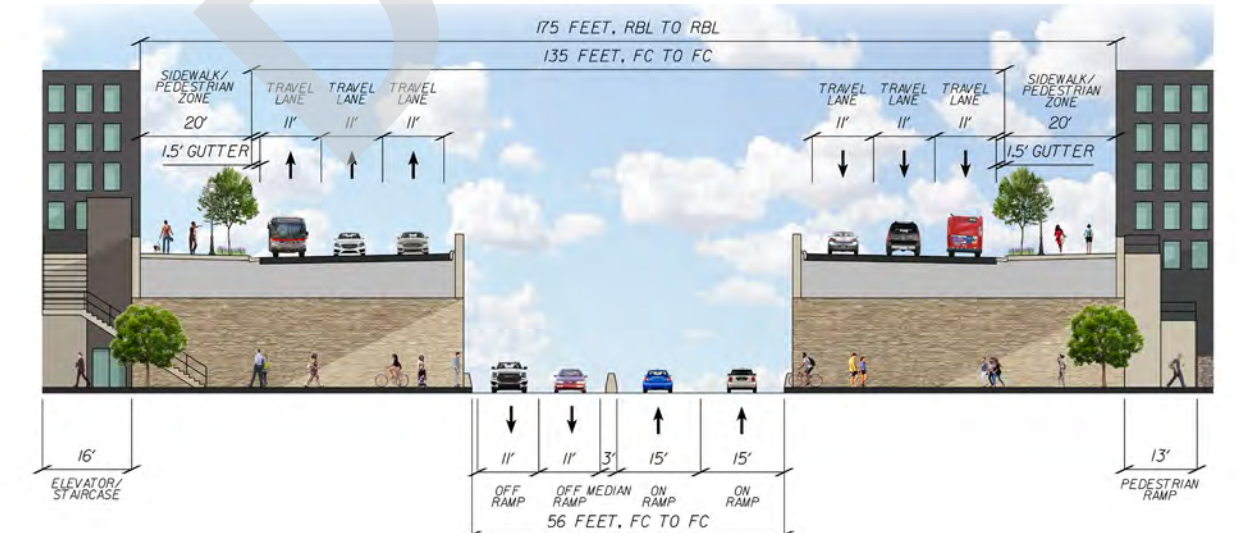
Alternative Route 1 At-Grade Alignments



Route 1 Cross Section at 15th Street (Looking North)

The feasibility of an alignment for a grade-separated concept was analyzed in the same way as the at-grade concept design. In this case, only one alternative was analyzed—the Sector Plan’s “inverted” single point urban interchange (SPUI) in which the ramps are on the inside of the interchange (versus outside in a more traditional SPUI), creating a single intersection at 15th Street S rather than the two intersections that exist today.

With the development of a grade-separated alignment, the study team also examined potential cross sections for the Sector Plan’s version of urban boulevard. A typical cross section is shown in the figure below. Note that to achieve pedestrian and bicycle connectivity between Route 1 and 15th Street S (or 18th Street S), ramps, stairs, and elevators would be required. Future redevelopment could provide some of this connectivity.



Grade-Separated Cross Section

# Considering Cross-Sectional Elements and Design Criteria

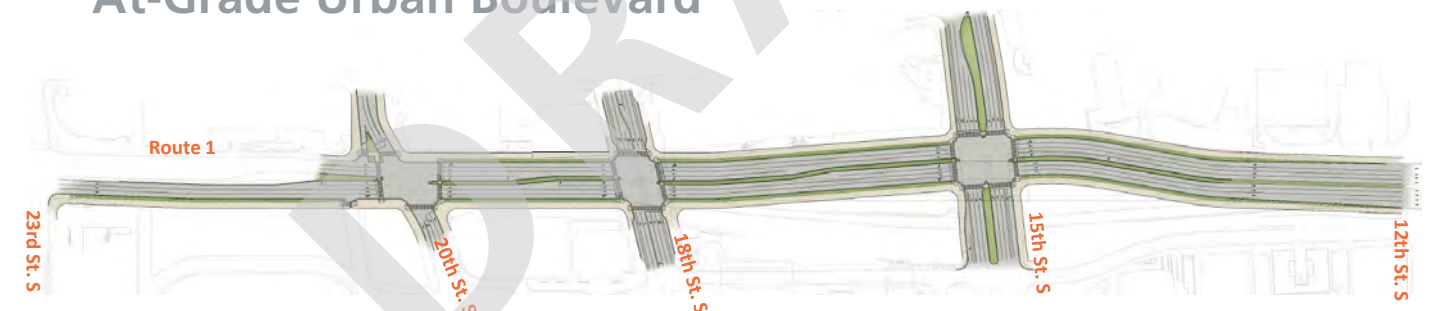
In the development of multiple concepts for an at-grade and grade-separated Route 1, the following elements and design criteria were used to develop concepts that met study goals:

- **Pedestrian Zone:** A focus area of the Route 1 streetscape and consistent with the Crystal City Sector Plan, this zone would be a minimum width of 20 feet and would be made up of a pedestrian walk area, landscaping, human-level lighting, benches, and space for outdoor café seating. Creating a wide, flexible space between the street curb and future land development would provide options in the future for what would best meet the needs of the community.
- **Wide Sidewalks:** The pedestrian zones along Route 1 and 15th and 18th Streets would include wide sidewalks to enhance the ability of pedestrians to move freely through the corridor. Sidewalks could range anywhere from 8–20 feet depending on the proposed uses within the pedestrian zone of the cross section.
- **Street Trees and Landscaping:** To create an urban boulevard, trees, grass, and other landscaping would be planted in the median and between the curb and sidewalk. The landscaping has the added benefit of providing a safety buffer between cars and people as well as creating a space for streetlights and other utilities where they would not impede movement of people.
- **Building Facades:** In the ultimate condition, building facades would be adjacent to the sidewalk as in many urban environments and consistent with the Sector Plan. Business owners could work with VDOT and Arlington County to use part of the pedestrian zone as outdoor seating or dining space.
- **Bicycle Facilities:** While bicycle facilities would be included on streets crossing Route 1 (15th and 18th streets) and continue to be improved on parallel routes, bicycle facilities were not included in the concepts for along Route 1, given that bicycle facilities on Route 1 are not included in the Sector Plan or in the Bicycle Element of the Arlington County Master Transportation Plan. However, given the width of the pedestrian zones, bicycle facilities along Route 1 could be possible in the future if desired by the community.
- **Medians:** To further enhance aesthetics and pedestrian safety, medians with a minimum width of 10 feet were considered along the length of the study area. Street trees would be planted in the medians as a measure to encourage slower traffic and to create a more natural and comfortable streetscape. Medians also could provide a pedestrian refuge as an added safety measure for the at-grade configuration for people unable to cross or uncomfortable with crossing in a single phase.
- **Travel Lanes:** The concepts for Route 1 call for three through lanes in each direction to meet existing and future traffic and transit demands. The outside lane could be used in the future for off-peak on-street parking. To safely move trucks and buses through the area, the lanes were assigned a width of 11 feet, which is the minimum allowed by VDOT on a principal urban arterial that allows truck traffic.
- **Turn Lanes:** After much consideration following stakeholder input and coordination with Arlington County, turn lanes were removed from initial concepts where possible to provide shorter crossing distances for pedestrians and to improve safety. The at-grade concepts include shared right-through lanes instead of dedicated right-turn lanes.

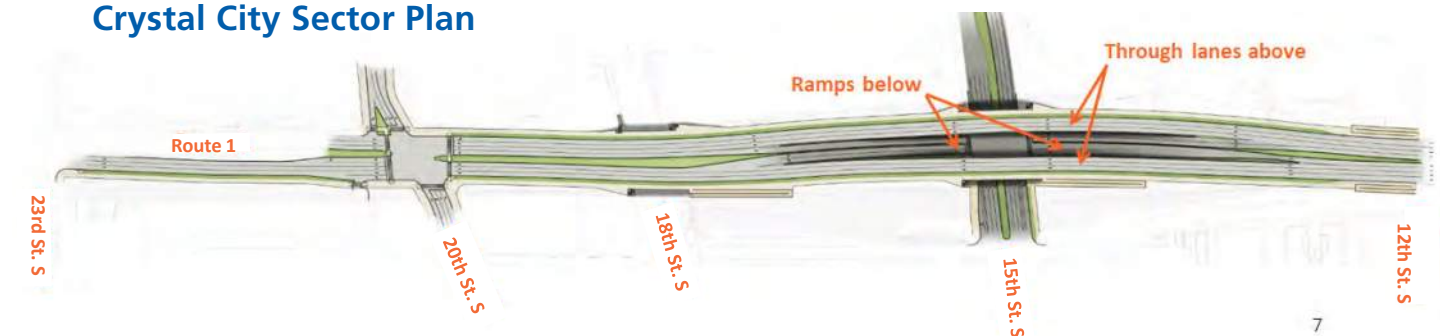
- **Design Speed:** The design speed used for concept development was 30 mph. The proposed speed limit would be reduced to 30 mph, pending a speed study. It is VDOT's intent that this speed limit combined with the geometric features discussed herein—especially horizontal curves, street trees, streetlights, well-marked pedestrian and bicycle crossings, signs, and traffic signals—would serve to slow vehicle speeds.
- **Corridor Width:** The Sector Plan defined the width of corridor—the distance between building facades in the final condition where an urban boulevard would be located—as a consistent 140 feet where possible. This width provides flexibility for development in the future of the potential excess right-of-way that would result from the conversion of Route 1 to an urban boulevard.
- **Utilities:** A large number of utilities were previously consolidated under the now-demolished S Clark Street alignment parallel to Route 1 on the east side. To prevent conflict with future development, utilities are proposed to be relocated to the Route 1 corridor.
- **Urban Design Guidance:** The following documents guided conceptual design features such as reduced speeds (30 mph), tighter curb radii, reduced lane width, trees and landscaping, medians and curb extensions, and potential for future on-street parking and bike lanes along Route 1: American Association of State Highway and Transportation Officials (AASHTO) [Policy on Geometric Design of Highways and Streets](#), National Association of City Transportation Officials (NACTO) [Urban Design Guide](#), and the VDOT [Road Design Manual](#).

Renderings of an at-grade concept (Option 1) and the grade-separated Sector Plan concept are shown in the figure below.

## At-Grade Urban Boulevard



## Elevated Urban Boulevard Crystal City Sector Plan



At-Grade and Elevated Route 1 Concepts

## Screening Various Concepts

With initial concepts developed, the study team developed and screened variations of these concepts by considering stakeholder and public input, especially from PIM #2 in March 2020, as well as using current and future year traffic projections and design and construction feasibility.

## Stakeholder and Public Input

This Route 1 Multimodal Study included multiple stakeholder and public meetings for VDOT to receive input and guidance related to the scenarios. Design and traffic analysis elements were presented to the public for comment and review. Design considerations included modifying the typical sections to minimize turn lanes and the total number of lanes across Route 1, a widened landscaped median, and an additional at-grade configuration ("Concept G," discussed below). Additionally, the public input identified the need to further study and develop potential options for a non-auto underpass or overpass for crossing Route 1 at 18th Street in the at-grade scenario.

## Design Feasibility

The feasibility of the design and implementation of each of the potential configurations also was analyzed. The design feasibility concept screening identified constraints based on AASHTO, NACTO, and VDOT guidance. The design screening verified that the at-grade and grade-separated Sector Plan concepts were all feasible alternatives that could be constructed to VDOT design standards.

## Traffic Operations Screening

In addition to screening for design and constructability, a high-level review of the impact to traffic operations was conducted for several

iterations of initial design concepts. These iterations included exploring the impact of dedicated versus shared right-turn lanes, the number of left-turn lanes, the number of through lanes along Route 1, and various turn restrictions. A conservative screening analysis was conducted using the 2025 and 2040 AM and PM peak hour traffic forecasts provided by Arlington County, with some localized reassignment in the study area as needed. These traffic volumes conservatively assumed that the traffic volumes along Route 1 would continue to increase and be consistent with those for the No-Build or grade-separated scenarios.

Traffic operations were screened at a high-level using Synchro software looking at overall intersection delay and level of service (LOS). The screening analysis resulted in at-grade concepts generally showing high delays, especially at the Route 1/15th Street S intersection during the AM peak hour.

The analysis showed that conventional four-way intersections operated poorly with the design volumes. A more traditional solution to overcome this congestion would be to add turn lanes (i.e., increase capacity); however, given the feedback from stakeholders and the public, adding turn lanes (especially double left-turn lanes) was not an option. Multiple left-turn lanes are not conducive to pedestrian safety, nor are right-turn lanes. Thus, based on this feedback, VDOT selected a maximum of seven lanes for the Route 1 legs of the intersections with 15th Street S and 18th Street S.

Thus, the study team moved forward with the following concepts:

- Concept C (all turning movements permitted at 15th and 18th Streets), which became **At-Grade Option 1**
- Concept F (left turns from Route 1 prohibited at 15th and 18th Streets), which narrowed the Route 1 typical section to 6 lanes, providing a wider center median with additional plantings possible, and which became **At-Grade Option 2**

- Concept G, a "hybrid" concept of Concepts C and F (left turns at Route 1/15th Street, no left turns from Route 1 nor from 18th Street) included at request of Arlington County staff, which became **At-Grade Option 3**
- Grade-separated Sector Plan concept
- Improvements on existing conditions

The intersection configurations for the three at-grade concepts are shown in the figure below.



Intersection Laneage for At-Grade Configurations: Options 1, 2, and 3

## Slowing Southbound Traffic

In rounding out the discussion of conceptual designs for a Route 1 urban boulevard, slowing traffic coming off of I-395 or Route 110 and heading south through Crystal City is a key to pedestrian safety. Before vehicles reach 15th Street S in the at-grade concepts or 20th Street S in the Sector Plan concept, those vehicles should be traveling close to 30 mph. This slowing of southbound vehicle traffic coming from Route 110 and I-395 could be done with the following measures:

- **Education and Enforcement Measures:** regulatory and warning signage, lowering the speed limit, community coordination with police, installing radar speed feedback signs

- **Periodic Measures:** rumble strips/grooved pavement, high visibility pedestrian (and bicycle) crosswalks
- **Continuous Measures:** curves and other geometric features to slow traffic, street trees and pedestrian lighting, possible off-peak on-street parking

All of these measures could combine to effectively slow southbound traffic before it reaches the first signalized intersection on Route 1 in Crystal City.



## Evaluating Concepts

The refined potential corridor concepts—at-grade Options 1, 2, and 3, the Sector Plan concept, and the modified existing conditions concept—were further evaluated for feasibility based on the following analyses:

## Constructability/Sequence of Construction

The at-grade concepts and grade separated concept are feasible to construct while also being able to maintain pedestrian, bicycle, transit, and vehicular travel patterns using an approach that would involve six major phases of construction. Several sub-phases of work such as sidewalk detours and other shifts in travel patterns would likely be needed within the major construction phases.

## Stormwater Management (SWM) Considerations

The at-grade concept design scenarios (Options 1, 2, and 3) and the grade-separated Sector Plan concept were found to reduce the overall flow of stormwater as compared to existing conditions

due to the significant reduction in impervious area existing conditions. Neither configuration is anticipated to require major best management practice (BMP) facilities, which are challenging to construct in such an urban corridor. The SWM needs can be met through the mix of reducing impervious area for water quantity, implementing low-impact development (or biophilic) solutions with the streetscape, and purchasing nutrient credits to meet the water quality requirements.

## Developable Land

As a part of the design of both the at-grade and grade-separated concepts, the scenarios tighten the width of the corridor using urban design standards and narrower lanes to create additional developable land on both sides of the corridor. The at-grade conceptual design identified approximately 6-1/2 acres of excess right-of-way and easements which could be reallocated for future development. The grade-separated concept identified approximately 5 acres of excess right-of-way and easements which could be reallocated for future development.

## Planning-Level Conceptual Cost Estimates

This phase of the Route 1 study analyzed the potential project costs for both the at-grade and grade-separated configurations, considering bridges, culverts, large drainage structures, large retaining walls, lighting, earthwork considerations, bicycle and pedestrian facilities, and environmental considerations. The cost estimates are summarized in the table below. For the lower-cost option of improving the existing Route 1 highway configuration, VDOT assigned a cost range of \$5M to \$15M for such a project.

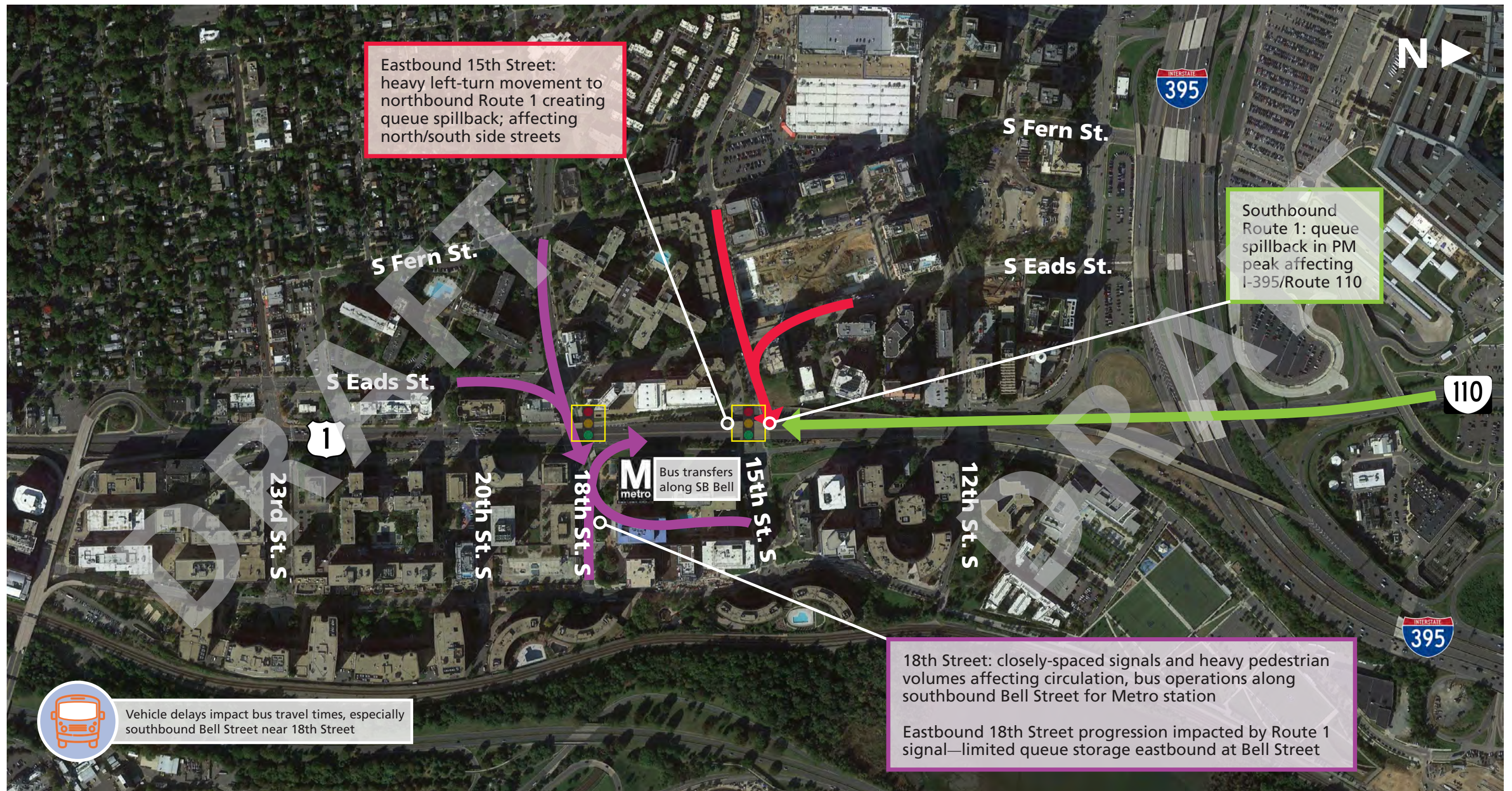
## Multimodal Transportation Operations and Safety

Transportation and safety-related analyses were conducted for the at-grade concepts. It was assumed from a feasibility perspective that the grade-separated Sector Plan concept would operate similarly to the future No-Build conditions (i.e., in which the 15th Street S crossing remains an interchange and the 18th Street S crossing remains separated with no interaction with Route 1). In general as shown in the figure on the following page, it is anticipated that poor traffic operations and safety challenges would be manifested with an at-grade Route 1 if traffic volumes remain consistent with 2019 (pre-pandemic) volumes or increase in the future, which is how future-year traffic operations are typically analyzed. However, this type of analysis likely represents a conservative “worst case” analysis that does not account for considerations such as significant planned investments in parallel transit service to Route 1 or for the historically flat “growth” in traffic along Route 1 in the study area, as shown in the figure at the top of page ES-22.

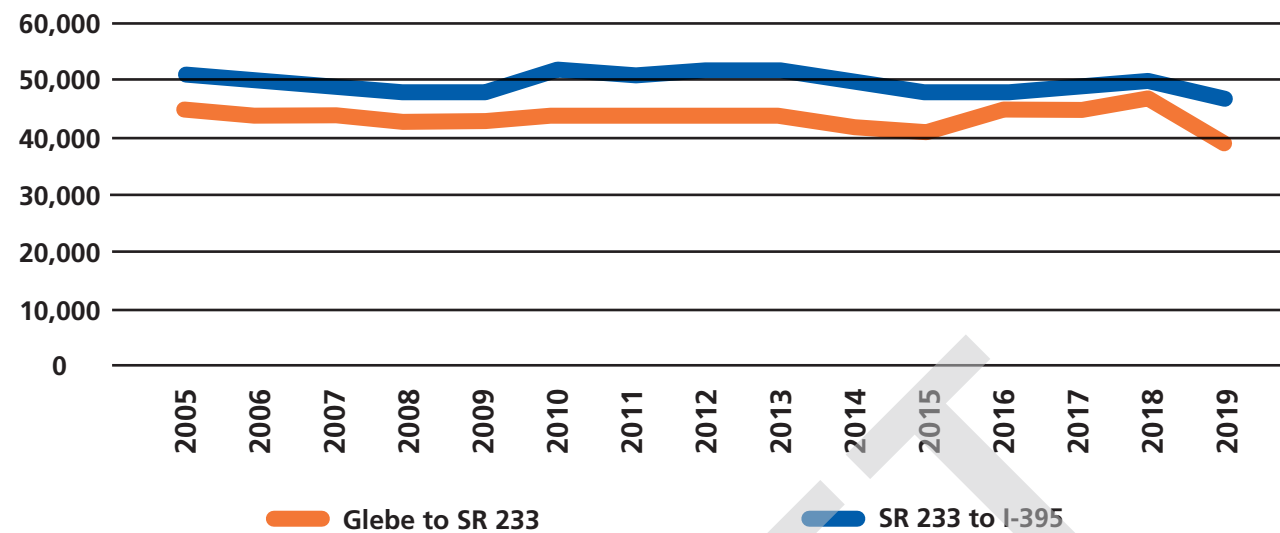
Conceptual Cost Estimates

Phase	At-Grade Configuration (\$ millions)	Grade-Separated Sector Plan Configuration (\$ millions)	Modified Existing Grade-Separated Configuration (\$millions)
Preliminary Engineering (Design, Environmental, Permitting)	\$16	\$24	
Right-of-Way	\$3	\$2	
Construction (Including Utilities)	\$160	\$234	
Total Estimate	\$180	\$260	\$5 to \$15

## At-Grade Options: Key Challenges/Constraints



Route 1 Average Daily Traffic Volumes: 2005 to 2019



In Pentagon City and Crystal City, in addition to Arlington County's significant Complete Streets program, the Commonwealth of Virginia has committed to significant investments for enhanced rail and transit, as shown in the figure on the following pages. This funding, along with local and regional funding, will further enhance the multimodal network in the Crystal City and Pentagon City areas.

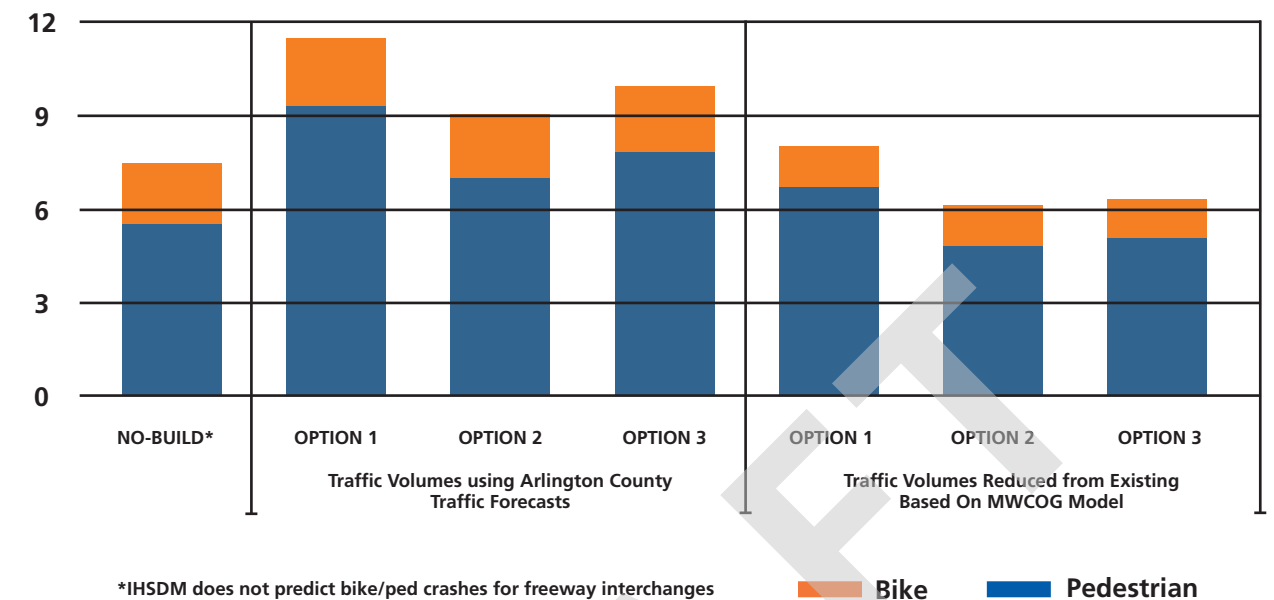
Furthermore, empirical evidence exists from a limited number of freeway-to-at-grade conversion projects around the US that traffic volumes decrease given the reduction in capacity, and trips are absorbed into the regional street network or diverted to other modes. Thus, with continued focus on an increasingly effective travel demand management (TDM) program considering the travel patterns in Crystal City, there are several potential opportunities and targeted trips for encouraging people to switch modes, which will have the effect of reducing traffic on Route 1.

## Considering Pedestrian and Bicycle Safety

With awareness of Arlington County's recently approved Vision Zero Action Plan, and considering a potential reduction in future year traffic, a safety analysis was conducted for Route 1 within the project study area using predictive methods to estimate future-year crashes for No-Build conditions against various Build options.

- Results of these analyses suggested an increase in crashes in the at-grade Build options when using the Arlington County traffic forecasts (i.e., when using consistent traffic volumes with the No-Build condition).
- Using reduced traffic volumes—potentially possible with the implementation of a robust TDM program and significant mode shifts to transit and other travel options—the analysis of the at-grade Build options resulted in generally consistent or reduced crashes as compared to No-Build conditions, as shown in the bar chart on the next page.
- Contributing to this result, the at-grade Build options feature a reduced speed limit along Route 1 and restrictions in left turns, both of which should improve safety.

Predicted Bike/Ped Crashes per Year for Route 1: I-395 to 23rd Street S



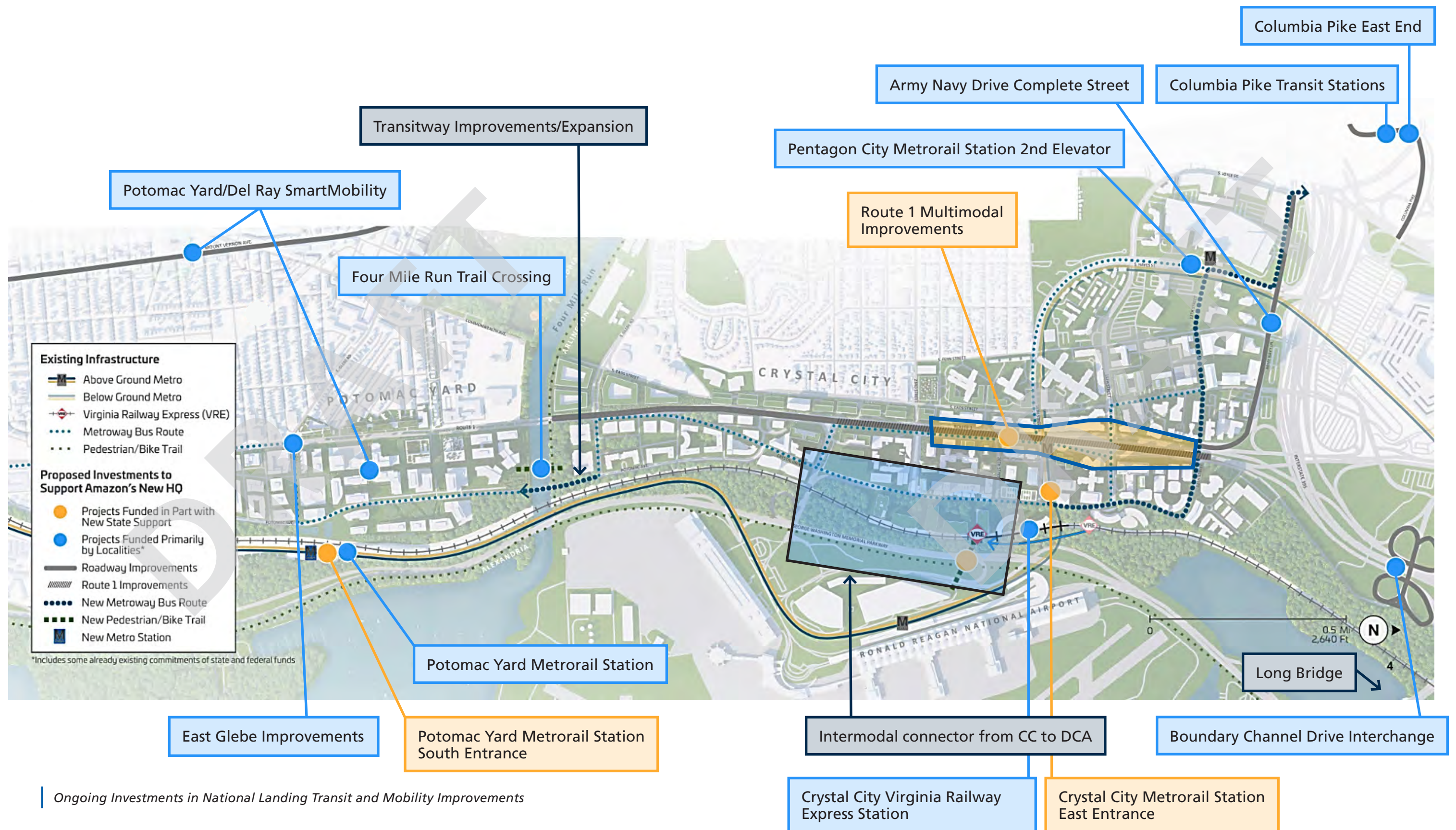
## Drawing Conclusions

From the analyses, the VDOT study team drew conclusions on the following four concepts:

- At-Grade Configuration – Option 1:** All turning movements permitted at 15th and 18th Streets
- At-Grade Configuration – Option 2:** Left turns from Route 1 prohibited at 15th and 18th Streets, which narrowed the Route 1 typical section to 6 lanes providing a wider center median
- At-Grade Configuration – Option 3:** A “hybrid” of Options 1 and 2 with left turns at Route 1/15th Street and no left turns at Route 1/18th Street
- Grade-Separated Sector Plan Configuration:** Modified SPUI at 15th Street S, with ramps on the inside of the Route 1 travel lanes (i.e., an “inverted SPUI”), and a grade-separated overpass at 18th Street S

The examination of these four concepts involved feasibility analyses based on the goals of this study to incorporate safety, multimodal access and accommodation, transit effectiveness, vehicular operations, and environmental features, all to fit within the urban fabric and context of Crystal City. The analyses resulted in the following conclusions:

- All four concepts are constructable
- Stormwater management is feasible with each concept
- More developable land is possible with the at-grade concepts
- The pedestrian zone will be able to provide ample room for sidewalks, street trees, and other amenities
- Planning-level cost estimates indicated that at-grade concepts are less costly (with the exception of making some improvements to the existing conditions)
- Multimodal transportation and safety analyses revealed concerns with the at-grade concepts if vehicular traffic increases based on traditional traffic forecasting methods



Ongoing Investments in National Landing Transit and Mobility Improvements

Given the last conclusion, should traffic volumes in the study area decrease in conjunction with an at-grade concept implemented in concert with regional and local transit projects and a robust TDM program, it would be anticipated that multimodal transportation operations and safety would not be significantly adversely affected. Some minor increases in vehicle peak-hour travel times and delays would still be anticipated due to the removal of grade-separated crossings. The predicted future number of crashes along the corridor would not show a significant increase or could even show a decrease, given that the at-grade concept includes a reduction in the study area speed limit and design speeds and mitigates an existing weaving area between I-395 and the 15th Street S interchange.

Of the three at-grade options, Option 3 was chosen as the optimum concept given the following reasons:

- Option 3 provides all turning movements to/from Route 1 at 15th Street S, thus addressing multimodal transportation demand
- Option 3 limits left-turn movements at the Route 1/18th Street S intersection, which removes several conflict points with pedestrian crossings, decreases the number of traffic signal phases, and maximizes pedestrian crossing times
- Option 3 (and all at-grade concepts) would include speed reduction mitigations for vehicles coming from I-395 and Route 110, including signage, pavement markings, and more active measures such as speed feedback signs



## Applying Measures of Effectiveness

In conducting the multimodal transportation analyses and developing and analyzing potential concepts, the VDOT study team applied the following MOEs to draw conclusions about three potential urban boulevard configurations for Route 1—modified existing, at-grade Option 3, grade-separated Sector Plan concepts:

-  **Safety (Crashes):** Comparison of concepts in the anticipated reduction in crashes
-  **Walkability:** Pedestrian comfort and interest in walking across and along Route 1
-  **Bikeability:** Bicyclist ease of mobility and routing along and across Route 1
-  **Transit Effectiveness:** Ease of operations for transit vehicles and access, such as access to Metro and bus transit facilities and potential congestion which could affect transit operations
-  **Vehicular Traffic Operations:** Traffic operations using the Vissim modeling tool
-  **Pedestrian Operation and Safety:** Pedestrian operations and pedestrian safety review
-  **Shift In Trips to Non-Auto Modes:** Comparisons of the shift in trips from vehicular modes to non-vehicular modes such as Metro, bicycle, and pedestrian modes
-  **Cost:** Analysis of the cost of the Route 1 multimodal improvement concepts
-  **Constructability:** Challenges and time associated with the construction of each of the conceptual scenarios and the need to keep pedestrian, bicycle, and vehicular traffic moving at all times during construction
-  **Americans with Disabilities Act (ADA) considerations:** Analysis of the proposed design features with respect to compliance with ADA
-  **Urban Fabric:** Review of the ability of the potential for a concept to fit into the context of the urban nature of Crystal City and to knit together the land uses and grid of streets
-  **Redevelopment Potential:** Amount of developable land which may become available
-  **Adaptability:** Different urban boulevard concepts to adapt to changes that may take place in the future including additional development, reduced vehicular volumes, introduction of autonomous vehicles, and other future possibilities
-  **Environmental Impacts:** Reduction in impervious area along with the potential for aesthetic and positive social impacts
-  **Maintenance:** Reviews of the potential future maintenance costs and needs, including roadway infrastructure, bridges, retaining walls, lighting, and traffic signal costs

The initial comparisons of the modified existing, at-grade, and grade-separated Sector Plan configurations to selected MOEs are summarized in the first table below. The comparisons of the three possible urban boulevard configurations using the MOEs can be translated to ratings when compared to the existing configuration. As shown and

described previously, the at-grade concept performs worse than the other concepts in terms of safety (including pedestrian operations and safety), transit effectiveness, and vehicular traffic operations—if traffic volumes were to increase from 2019 (pre-pandemic) counts and further mitigation is not provided to increase bicycle and pedestrian safety.

Initial MOE Comparisons without Possible Safety and Operations Mitigations

Scenario	Safety (Crashes)	Walkability	Bikeability	Transit Effectiveness	Vehicular Traffic Ops	Pedestrian Ops/Safety	Shift in trips to non-auto modes	Cost	Constructability	ADA Considerations	Urban Fabric	Redevelopment Potential	Adaptability	Environmental Impacts	Maintenance
Modified Existing															
At-Grade															
Sector Plan Concept (Elevated/Rebuilt)															

Better

Worse

However, if a robust TDM strategy is implemented and if additional pedestrian and bicycle safety measures are implemented (such as a grade-separated pedestrian bridge or underpass is

constructed at 18th Street S.), MOEs for the at-grade configuration improve as shown in the table below.

MOE Comparisons with Possible Safety and Operations Mitigations

Scenario	Safety (Crashes)	Walkability	Bikeability	Transit Effectiveness	Vehicular Traffic Ops	Pedestrian Ops/Safety	Shift in trips to non-auto modes	Cost	Constructability	ADA Considerations	Urban Fabric	Redevelopment Potential	Adaptability	Environmental Impacts	Maintenance	Supports National Landing Vision?
Modified Existing																
At-Grade																
Sector Plan Concept (Elevated/Rebuilt)																

May be improved with overpass/underpass

May be improved with effective TDM strategy

Better

Worse

The following table provides a summary comparison of all three configurations with selected MOEs, as well as additional study needed. Note that the at-grade urban boulevard (Option 3) is the lower-cost urban boulevard configuration and the one that is most compatible with the vision for National

Landing. Pedestrian safety concerns will need to be addressed with further study, and a TDM strategy is needed to mitigate the potential for traffic congestion to affect the safety and efficiency of other modes.

Comparison of Possible Route 1 Urban Boulevard Configurations with Selected MOEs

Configuration	Pedestrian Safety	Multimodal Traffic Demand	Project Cost	Urban Boulevard	Vision for National Landing
At-Grade Urban Boulevard	Concerns need to be addressed w/ further study	Needs strategy that reduces future traffic volumes	Moderate \$180M	Yes	Compatible
Elevated Urban Boulevard (Sector Plan)	Accommodates	Accommodates	High \$260M	Yes	Impedes future development of National Landing
Improved Existing Elevated Roadway	Accommodates	Accommodates	Low \$5-15M	No	Not compatible

## Recommending At-Grade Option 3

From the findings and conclusions of this Phase 1 study and based upon the comparisons of the concepts using the 15 MOEs, it is VDOT's recommendation to convert the segment of elevated urban freeway in Crystal City to an at-grade, tree-lined urban boulevard with wide spaces along Route 1 for sidewalks, street trees, lighting, and other amenities desired by Arlington County citizens and landowners—and with safe crossings of Route 1 for pedestrians, bicyclists, and other users. An at-grade configuration for Route 1 provides the most desirable characteristics that meet the multimodal and community vision for National Landing.

It is believed that this recommended configuration will provide the greatest benefit to the corridor in the context of an evolving walkable, connected, and urban Crystal City. This at-grade scenario recommendation weighed vehicle throughput and corridor levels of service with those of environmental sustainability, walkability, redevelopment potential while considering a safe environment for all users.

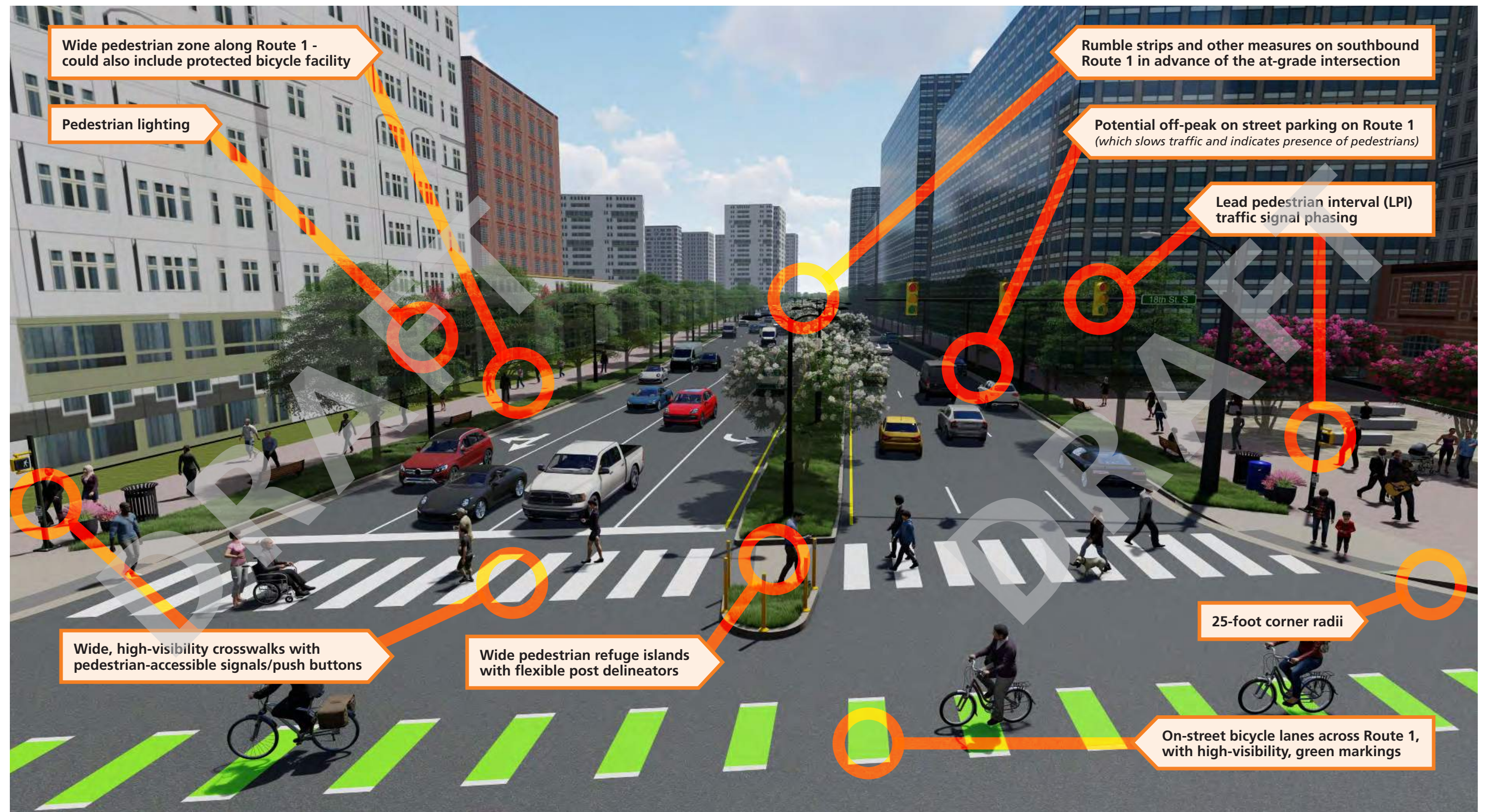
### Accommodating Bus Transit

As part of the recommended at-grade option, the existing bus stops along 18th Street S (the sawtooth bus bays underneath Route 1) will need to be relocated. While not part of this VDOT Route 1 project, a multimodal transfer facility, as envisioned in the Sector Plan and centered around the current Crystal City Metro station, could replace existing bus stops on 18th Street S and serve to encourage people to use the bus transit mode of transportation.

### Recommending Bicycle and Pedestrian Safety Elements

Further safety elements that are recommended for future phases of design include leading pedestrian intervals (LPIs) at traffic signals, pedestrian lighting, and a pedestrian overpass or underpass at 18th Street S. Details of these safety features would be evaluated in future phases of design. Many of these potential elements are shown in the figure on the following pages.





At-Grade Route 1 Intersection Safety Features

This recommended at-grade configuration is consistent with the national trend to remove urban freeways to create more vibrant street spaces, healthier environments, and increased economic opportunities. A plan view of the recommended configuration is shown on this page, with new sidewalks and high-visibility crosswalks and with upgraded bicycle lanes and marked bicycle crossings of Route 1. Renderings of this recommended configuration are also shown on the following page.

The recommended concept provides for a reconstructed Route 1 that will provide:

- Walkable access along Route 1 between 15th Street S and 20th Street S to buildings, parks, and transportation facilities

- Wide, high-visibility pedestrian crosswalks and bicycle crossings of Route 1, with pedestrian refuges and shorter crossing distances than exist today
- Accommodations for vehicles and buses while providing opportunities for wide sidewalks and other amenities along Route 1 that will embrace the future fronts of buildings
- Support of the vision for National Landing (i.e., for knitting together the urban fabric, providing a safe environment for all modes, and enhancing economic vitality in the corridor)

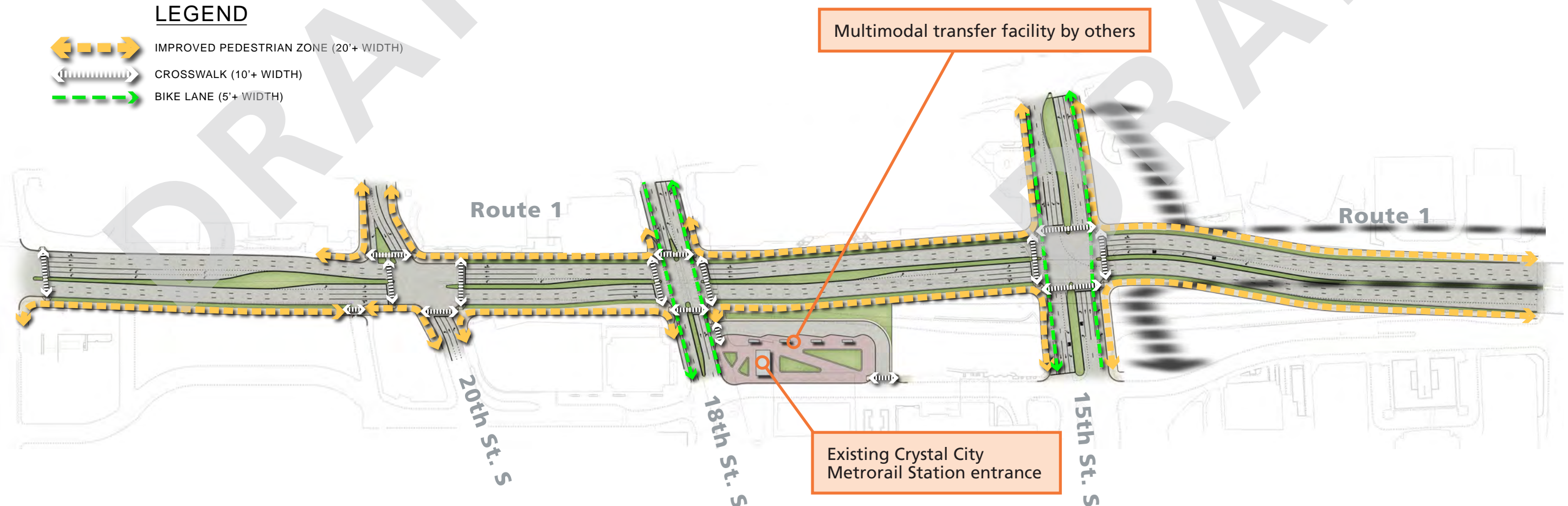
Considering the figure below, the implementation of the at-grade configuration would include:

- 2,100 linear feet of bike lanes
- 1,135 linear feet of crosswalks with wide pedestrian refuges
- 8,000 linear feet of sidewalks—including 3,250 linear feet of new sidewalks
- 124,000 square feet (2.8 acres) of walkable pedestrian space
- 1,600 linear feet of new medians
- 190 new trees along Route 1

- 78,000 square feet (1.8 acres) of landscaping
- Removal of 85,000 square feet (1.9 acres) of pavement
- 6.5 acres of excess right-of-way that may be converted to new land uses

## LEGEND

- IMPROVED PEDESTRIAN ZONE (20'+ WIDTH)
- CROSSWALK (10'+ WIDTH)
- BIKE LANE (5'+ WIDTH)



Rendering of Recommended At-Grade Urban Boulevard with pedestrian and bicycle facilities



Rendering of Recommended At-Grade Urban Boulevard – Route 1 at 18th Street (Looking West)



Rendering of Recommended At-Grade Urban Boulevard – Route 1 at 15th Street (Looking Southwest)



Rendering of Recommended At-Grade Urban Boulevard – Route 1 at 15th Street Looking North)



## Recommending Next Steps

In addition to the recommendation for the at-grade Option 3 configuration—an at-grade concept with all turns at 15th Street S and no left turns at 18th Street S—VDOT recommends that this Route 1 Multimodal Improvements Study conclude with Phase 2 of the study.

Based upon the findings of the Phase 1 analyses and the conclusions discussed above, Phase 2 will include:

- Updated multimodal counts and analyses
- Development of a comprehensive TDM strategy, which would be needed to:
  - Reduce future traffic volumes below existing (2019) volumes
  - Mitigate future congestion and potential diversion of traffic onto local and regional roads
- Examining the feasibility of a potential pedestrian underpass or overpass at 18th street
- Expanding on the analysis of Option 3
- Reviewing Route 1/23rd Street S with the recommendations of the County's Vision Zero Action Plan for any potential interim improvements that could be implemented ahead of Arlington County's 23rd Street Improvements and street improvements by the development community
- Advancement of plans to support other project development steps
- Further public engagement
- In accordance with Arlington's Vision Zero Action Plan, performing an engineering speed study to consider a 25-mph speed limit

## Acknowledgments

This study was prepared by the Virginia Department of Transportation (VDOT), Northern Virginia District, to examine the feasibility of implementing multimodal improvements to Route 1 in the Crystal City area of Arlington County, VA. VDOT has completed Phase 1 of this study, in close coordination with Arlington County Department of Environmental Services (DES) Transportation Division, and with input from the Route 1 Task Force and its representatives of the civic associations within zip code 22202. VDOT was assisted by Kimley-Horn, in association with HDR, ALA, DMY, and Sharp & Company, through a consultant contract, State Contract Number 0001-000-894, P101 for project UPC 115882.



## Route 1 Task Force

- Crystal City Citizens Review Council
- National Landing BID
- Arlington Ridge Civic Association
- Aurora Highlands Civic Association
- Crystal City Civic Association
- Arlington County Planning Commission
- Arlington County Transportation Commission
- Arlington County Bicycle Advisory Committee
- Arlington County Pedestrian Advisory Committee
- Arlington County Transit Advisory Committee
- Arlington County Transportation Division
- City of Alexandria
- VRE
- WMATA
- MWAA
- NPS
- VDOT

## Consultant Team

Kimley»Horn



ENGINEERING CONSULTANTS INC.







# PHASE 1 DRAFT REPORT

Prepared For:



Prepared By:



August 31, 2021

# Route 1 Multimodal Improvements Study

## Phase 1 Draft Report

Prepared for:



4975 Alliance Drive  
Fairfax, VA 22030

Prepared by:



11400 Commerce Park Drive  
Suite 400  
Reston, VA 20191

August 31, 2021



# Route 1 Multimodal Improvements Study

## Phase 1 Draft Report

### Contents

<b>1. Introduction .....</b>	<b>1</b>
1.1. Overview .....	1
1.2. Study Purpose and Goals.....	3
1.3. Guiding Documents .....	4
1.4. Study Scope and Schedule .....	6
1.5. Report Overview .....	7
<b>2. Project Context and Study Methodology.....</b>	<b>8</b>
2.1. History of Route 1 in Crystal City.....	8
2.2. Route 1 Today .....	10
2.3. Study Methodology and Assumptions .....	12
2.3.1. Concept Planning Study Area.....	12
2.3.2. Transportation Analysis Study Area .....	12
2.3.3. Measures of Effectiveness.....	17
2.4. Summary.....	18
<b>3. Existing Conditions.....</b>	<b>19</b>
3.1. Existing Geometric and Infrastructure Conditions.....	19
3.1.1. Existing Cross Sections .....	19
3.1.2. Existing Bridges, Retaining Walls, and Subsurface Structures.....	27
3.1.3. Existing Pavement and Geotechnical Conditions.....	29
3.1.4. Existing Drainage and Stormwater Management.....	30
3.1.5. Existing Utilities .....	31
3.1.6. Existing Environment and Urban Form.....	31
3.2. Historic Vehicle Traffic Counts .....	34
3.3. Existing Multimodal Transportation Conditions .....	36
3.3.1. Existing Pedestrian Analysis.....	37
3.3.2. Existing Bicycle Analysis.....	42
3.3.3. Existing Transit Analysis .....	46

3.3.4.	Existing Vehicle Analysis .....	49
3.3.5.	Historical Crash Analysis .....	55
3.4.	Existing Conditions Summary.....	61
<b>4.</b>	<b><i>Future Conditions without Route 1 Improvements.....</i></b>	<b>62</b>
4.1.	Land Use Forecasts and Background Developments.....	62
4.2.	Background Transportation Network Improvements.....	64
4.3.	Bicycle and Pedestrian Forecasts .....	67
4.4.	Vehicular Traffic Forecasts .....	67
4.5.	Future No-Build Conditions Analysis Summary .....	68
<b>5.</b>	<b><i>Stakeholder Involvement.....</i></b>	<b>69</b>
5.1.	Route 1 Task Force .....	69
5.2.	Public Outreach .....	70
5.3.	MetroQuest Public Engagement Survey .....	71
5.4.	Public Information Meeting #1 Overview and Promotion .....	72
5.5.	Public Information Meeting #2 Overview and Promotion .....	74
5.6.	Public Information Meeting #3 Overview and Promotion .....	76
5.7.	Additional Stakeholder Interface.....	78
<b>6.</b>	<b><i>Concept Development .....</i></b>	<b>79</b>
6.1.	Balancing Competing Needs in the Street Space .....	81
6.2.	Cross Section Elements and Design Criteria .....	82
6.3.	Initial Concept Development.....	84
6.3.1.	Alternative At-Grade Alignments.....	84
6.3.2.	Initial At-Grade Cross Section.....	84
6.3.3.	At-Grade Profile .....	85
6.3.4.	Grade-Separated Sector Plan and Profile .....	87
6.3.5.	Initial Grade-Separated Cross Section .....	89
6.4.	Concept Screening .....	89
6.4.1.	Stakeholder and Public Input.....	89
6.4.2.	Design Feasibility .....	89
6.4.3.	Traffic Operations Screening .....	90
6.4.4.	Other Concepts Considered but Not Analyzed.....	92
6.4.5.	Other Design Options Not Precluded .....	92
6.5.	Conceptual Designs for Feasibility Analysis.....	92

6.5.1.	At-Grade Configuration – Option 1 .....	93
6.5.2.	At-Grade Configuration – Option 2 .....	96
6.5.3.	At-Grade Configuration – Option 3 .....	99
6.5.4.	Sector Plan Concept .....	99
6.5.5.	Modified Existing Concept .....	101
6.5.6.	Multimodal Transit Facility .....	101
6.5.7.	Reducing Speed of Southbound Traffic from I-395 and Route 110 .....	102
6.6.	Conclusions on Concept Development .....	104
<b>7.</b>	<b>Concept Evaluation.....</b>	<b>105</b>
7.1.	Constructability and Sequence of Construction .....	105
7.1.1.	At-Grade Concept .....	105
7.1.2.	Grade-Separated Configuration.....	107
7.2.	Stormwater Management Considerations .....	109
7.3.	Analysis of Developable Land .....	109
7.4.	Planning-Level Conceptual Cost Estimates .....	111
7.5.	At-Grade Multimodal Transportation and Safety Evaluation.....	113
7.5.1.	Multimodal Traffic Operations – Arlington County Forecasts .....	113
7.5.2.	Sensitivity Analysis – Travel Patterns and Mode Shift Considerations .....	127
7.5.3.	Origin-Destination (O-D) Data.....	133
7.5.4.	Macro-Level Sensitivity Analysis: MWCOG Model Diversion Estimation.....	134
7.5.5.	Micro-Level Sensitivity Analysis – Vissim Model with Reduced Traffic Volumes.....	136
7.5.6.	Pedestrian Capacity Considerations.....	140
7.5.7.	Safety and Crash Evaluation .....	140
7.6.	Concept Evaluation Summary .....	143
<b>8.</b>	<b>Conclusions and Recommendations.....</b>	<b>144</b>
8.1.	Conclusions on Project Need .....	144
8.2.	Conclusions on a Possible Route 1 Urban Boulevard .....	145
8.3.	Comparisons with Measures of Effectiveness .....	147
8.4.	Recommendation: At-Grade Configuration Option 3 .....	153
8.5.	Next Steps .....	157
8.6.	Implementation Process .....	158
8.7.	Closing .....	159

# List of Figures

Figure 1-1 Study Tasks and Schedule (Phase 1) .....	6
Figure 2-1 Concept Planning Study Area .....	13
Figure 2-2 Multimodal Transportation Analysis Study Area .....	15
Figure 2-3 Existing Intersection Lane Configurations within Analysis Study Area .....	16
Figure 3-1 Existing Route 1 Cross Section Between 23rd Street S and 20th Street S .....	20
Figure 3-2 Existing Route 1 – Between 20th Street S and 18th Street S Cross Section .....	21
Figure 3-3 Existing Route 1 – Between 18th Street S and 15th Street S Cross Section .....	22
Figure 3-4 Existing Route 1 – Between 15th Street S and 12th Street S Cross Section .....	24
Figure 3-5 Existing 20th Street S Cross Section (Looking East Toward Route 1) .....	25
Figure 3-6 Existing 18th Street S Cross Section (Looking East Toward Route 1) .....	26
Figure 3-7 Existing 15th Street S Cross Section (Looking East Toward Route 1) .....	27
Figure 3-8 Diagram of Underground Pedestrian Walkways Connecting Crystal City Shops .....	29
Figure 3-9 Existing Utilities in the Route 1 Study Corridor .....	31
Figure 3-10 Historic AADTs Along Route 1 in Study Area .....	35
Figure 3-11 Route 1 Cross Street Historic AADTs in Study Area .....	35
Figure 3-12 Route 1 Parallel Street Historic AADTs in Study Area .....	36
Figure 3-13 Pedestrian Network and AM and PM Peak Hour Pedestrian Volumes .....	39
Figure 3-14 Existing Sidewalk Width .....	41
Figure 3-15 Existing Bicycle Network .....	43
Figure 3-16 BLTS Scoring System .....	44
Figure 3-17 Study Area BLTS .....	45
Figure 3-18 Existing Transit Routes and Stops .....	47
Figure 3-19 Multimodal Transportation Analysis Study Area .....	50
Figure 3-20 Existing AM Peak Hour Traffic Volumes .....	51
Figure 3-21 Existing PM Peak Hour Traffic Volumes .....	52
Figure 3-22 Vissim Operational Analysis Area AM and PM Peak Hour Average Speed Maps .....	54
Figure 3-23 Crash Analysis Study Area .....	57
Figure 3-24 Route 1 Mainline Crash Analysis Histogram .....	59
Figure 4-1 Planned and Approved Developments in Study Area .....	63
Figure 4-2 Future No Build Street Network with Planned Improvements .....	64
Figure 4-3 On-Going Investments in National Landing Transit and Mobility Improvements .....	66
Figure 5-1 Travel Survey – Existing Use .....	72
Figure 5-2 Travel Survey – Design Priorities .....	72
Figure 6-1 Consideration of Study Purpose and Goals .....	79
Figure 6-2 Alternative Route 1 At-Grade Alignments .....	84
Figure 6-3 Initial Route 1 Cross Section at 15th Street (Looking North) .....	85
Figure 6-4 Concept Plan and Profile for At-Grade Concept .....	86
Figure 6-5 Concept Plan and Profile for Grade-Separated Sector Plan Configuration .....	88
Figure 6-6 Initial Grade-Separate Cross Section .....	89
Figure 6-7 Intersection Laneage for At-Grade Configuration Options 1, 2, and 3 .....	91
Figure 6-8 Plan view rendering of At-Grade Option 1 with multimodal transfer station at Crystal City Metro Station .....	94

Figure 6-9 Rendering of Option 1 – Route 1 at 15th Street S (Looking West) .....	95
Figure 6-10 Rendering of Option 1 – Route 1 at 15th Street S (Looking North) .....	95
Figure 6-11 Rendering of Option 1 – Route 1 at 18th Street S (Looking Northwest) .....	96
Figure 6-12 Plan view rendering of at-grade Option 2 with multimodal transfer station at Crystal City Metro Station .....	97
Figure 6-13 Rendering of Option 2 – Route 1 at 15th Street S (Looking Southwest) .....	97
Figure 6-14 Rendering of Option 2 – Route 1 at 18th Street S (Looking North) .....	98
Figure 6-15 Rendering of Option 2 – Route 1 at 18th Street S (Looking South) .....	98
Figure 6-16 Plan View Rendering of At-Grade Option 2 with Multimodal Transfer Station at Crystal City Metro Station .....	99
Figure 6-17 Plan View Rendering of Grade-Separated Sector Plan Configuration .....	101
Figure 7-1 Representative Construction Phasing Diagram (At-Grade Configuration) .....	107
Figure 7-2 Representative Construction Phasing Diagram (Grade-Separated Configuration) .....	108
Figure 7-3 Analysis of Potential Excess Right-of-Way (At-Grade Configuration) .....	110
Figure 7-4 Analysis of Potential Excess Right-of-Way (Grade-Separated Configuration) .....	110
Figure 7-5 Example 15th Street Multimodal Travel Times Crossing Route 1 – With 2025 AM Peak Hour Volumes .....	115
Figure 7-6 Example 18th Street Multimodal Travel Times Crossing Route 1 – With 2025 AM Peak Hour Volumes .....	116
Figure 7-7 Example Bus Travel Times – Key Transit Routes with 2025 PM Peak Hour Volumes .....	118
Figure 7-8 Example Vehicle Travel Times – Route 1 Corridor with 2025 AM Peak Hour Volumes .....	119
Figure 7-9 Example Average Speed Comparison – With 2025 AM Peak Hour Traffic Volumes .....	120
Figure 7-10 Key Traffic Challenges/Constraints for At-Grade Build Options .....	125
Figure 7-11 Key Traffic Challenges/Constraints for At-Grade Build Options (Zoom View) .....	126
Figure 7-12 Northbound Route 1 O-D's, 2019 Weekday AM Peak Period (Source: StreetLight Data) .....	133
Figure 7-13 Modeled Change in 2025 Average Daily Traffic Volumes with At-Grade Route 1 .....	135
Figure 7-14 Range of Potential Future Traffic Forecasts Analyzed .....	136
Figure 7-15 Key Study Area Travel Times, Existing (2019) AM Peak Hour Sensitivity Analysis .....	137
Figure 7-16. Existing (2019) AM Peak Hour Average Speed Comparison for Sensitivity Analysis Scenarios .....	138
Figure 7-17 Predicted Crashes per Year by Location for Route 1, I-395 to 23rd Street S .....	142
Figure 7-18 Predicted Crashes per Year by Severity for Route 1, I-395 to 23rd Street S .....	142
Figure 7-19 Predicted Bicycle and Pedestrian Crashes per Year for Route 1, I-395 to 23rd Street S .....	143
Figure 8-1 MOE Comparison of Possible Route 1 Urban Boulevard Configurations .....	152
Figure 8-2 MOE Comparisons with Possible Safety and Operations Mitigations .....	153
Figure 8-3 Recommended At Grade Urban Boulevard Configuration with Future Multimodal Transfer Facility, Pedestrian Facilities, and Bicycle Facilities .....	154

Figure 8-4 Rendering of Recommended At Grade Urban Boulevard at 15th Street S Looking Southwest .....	155
Figure 8-5 Rendering of Recommended At Grade Urban Boulevard at 18th Street S Looking Northwest.....	155
Figure 8-6 Rendering of Recommended At Grade Urban Boulevard at 15th Street S Looking South .....	156

## List of Tables

Table 3-1 Summary of Existing Structures Condition .....	28
Table 3-2 Existing Pedestrian Crossing Distance and Timings.....	38
Table 3-3 Existing Pedestrian Crossing Types.....	40
Table 3-4 Existing Route 1 Study Area Bus Service.....	48
Table 3-5 Total Study Area Crash Summary .....	56
Table 3-6 Intersection Crashes by Year .....	60
Table 4-1 Population and Employment Projections in Route 1 Study Area.....	62
Table 4-2 Background Transportation Network Improvements.....	65
Table 4-3 Forecasted Pedestrian Volumes for East-West Crossings of Route 1 .....	67
Table 6-1 Screening Analysis Results.....	90
Table 7-1 Conceptual Cost Estimate for At-Grade Concept 1 .....	112
Table 7-2 Conceptual Cost Estimate for Grade-Separated Sector Plan Concept .....	112
Table 7-3 Example Comparison of Intersection Delay and LOS/ – With 2025 AM Peak Hour Volumes .....	121
Table 7-4 Estimated Capacity of Parallel Transit Options.....	130
Table 7-5 Example Nationwide Elevated Freeways to At-Grade Projects.....	132
Table 7-6 Route 1 Study Area O-D Percentages from Various Locations, 2019 Weekday AM Peak Period (Source: StreetLight Data).....	134
Table 7-7 Change in MWCOC Model Daily Volume on Select Study Area Links, 2025 Model Year.....	135
Table 7-8 Comparison of Forecasted Pedestrian Volumes to Estimated.....	140
Table 8-1 Comparison of Possible Route 1 Urban Boulevard Configurations with Selected MOEs.....	151

## List of Appendices

**Appendix A: References**

**Appendix B: Existing Infrastructure Conditions Technical Reports**

B-1: Route 1 Feasibility Analysis Summary

B-2: Route 1 Existing Geotechnical Conditions Memo

B-3: Route 1 Conceptual Storm Drain SWM-BMP Report

**Appendix C: Existing Conditions Summary Report**

**Appendix D: Future No Build Conditions Summary Report**

**Appendix E: Task Force Meeting Summaries**

E-1 Task Force Meeting Summary, September 29, 2020

E-2 Task Force Meeting Summary, December 7, 2020

E-3 Task Force Meeting Summary, February 25, 2021

E-4 Task Force Meeting Summary, June 14, 2021

**Appendix F: Metroquest Survey Summary**

**Appendix G: Public Information Meeting Summaries**

G-1: PIM 1 December 16, 2020

G-2: PIM 2 March 3, 2021

G-3: PIM 3 June 16, 2021

**Appendix H: Conceptual Cost Estimates**

**Appendix I: Future Build Conditions Transportation Operations Summary**

# Phase 1 Interim Draft Report

## Route 1 Multimodal Improvements Study

### 1. Introduction

#### 1.1. Overview

US Route 1/Richmond Highway (Route 1) in the Crystal City area of Arlington County currently serves a variety of travelers—those who use the roadway as a regional connection to points north and south of Crystal City and those who use the roadway to access local destinations by walking, or biking, by using bus transit, Metro, or Virginia Railway Express (VRE), or by driving. The half-mile-long segment of Route 1 between 12th Street S and 20th Street S is

currently an elevated highway that forms a north-south barrier between those destinations to the east and west of Route 1 within National Landing and its neighborhoods of Crystal City, Pentagon City, and Potomac Yard, as well as the neighborhoods of Aurora Highlands and Arlington Ridge.



*Route 1 in Crystal City, Arlington County, VA*



*18th Street S in Crystal City*



*Crystal City Metro Station Area*

For many years, Crystal City and Pentagon City have been evolving from featuring auto-centric developments to higher-density, urban places that people can access by a variety of modes—walking, biking, riding a scooter, using transit, or driving. The introduction of Metrorail in the late 1970s and the Metroway bus rapid transit (BRT) system in the 2000s has spurred the ongoing transit-oriented development (TOD).

For the past 10 years, this evolution of Crystal City into a more multimodal area has been guided by Arlington County's *Crystal City Sector Plan* (Sector Plan) and its accompanying Crystal City Multimodal Transportation Study. Route 1 is a key component of the Sector Plan. The longer-term objective for Route 1 is to remove what is perceived as a barrier within Crystal City and convert the urban freeway segment of this road to an urban boulevard. Such a conversion would result in wide sidewalks, landscaped buffers with street trees, and an appropriate number of travel lanes to serve vehicles and transit. Converting Route 1 to an urban boulevard also would provide the opportunity for adjacent buildings to front the streets—for redevelopment projects to embrace Route 1 at their front doors.



**Amazon HQ2 Building Concept (Source: Amazon.com)**

As a result of the integrated land use and transportation planning, Crystal City and Pentagon City have attracted major new development projects, especially the establishment of Amazon's second headquarters (HQ2), which will bring 25,000 jobs or more to these areas, and which is leading to many other landowners to redevelop their properties. The November 2018 memorandum of understanding between Amazon and the Commonwealth of Virginia includes a commitment by the Commonwealth to implement transportation projects, including "mutually agreed upon improvements to Route 1." With this commitment, the Virginia Department of Transportation (VDOT) is taking the lead to develop and analyze the appropriate solutions for converting Route 1 to a multimodal, urban boulevard to "expeditiously evaluate and implement opportunities to improve safety, accessibility, and the pedestrian experience crossing Route 1."



*Existing Route 1 over 18th Street S.*

While this relatively short segment of urban freeway currently allows pedestrians, bicyclists, transit users, and traffic to cross under Route 1, the freeway makes walking or biking along Route 1 difficult and uncomfortable and creates a disjointed grid of streets. Some stakeholders have expressed that few people enjoy walking anywhere near a freeway. With the evolving urban land uses in Crystal City, there is a

desire on the part of many stakeholders to remove this segment of urban freeway, embrace Route 1 as a city street with storefronts and building entrances, and knit together the urban fabric of Crystal City.

***This Route 1 Multimodal Improvements Study examined the feasibility of various urban boulevard configurations—at-grade concepts, the grade-separated Sector Plan concept, and a concept that improves the existing elevated freeway—to meet the multimodal and other needs of this corridor. This report documents the analysis of the feasibility of implementing these various configurations and outlines the next steps for further study and project delivery.***

## 1.2. Study Purpose and Goals

The purpose of this study is to improve multimodal connectivity and accommodations along and across Route 1 in Crystal City to meet the changing transportation needs of this growing urban activity center. The arrival of Amazon's HQ2 and other ongoing development in the Crystal City/Pentagon City area is expected to increase multimodal transportation demand in an already heavily developed area with limited space for expanding the footprint of the transportation network. With increasing commercial and residential densities, there is a need to increase safety for all users including pedestrians, bicyclists, transit riders, and motorists, while also improving multimodal accessibility throughout Crystal City/Pentagon City, particularly to transit stations. Increased multimodal accessibility will improve person throughput for the corridor, which also should improve the pedestrian and bicycle experience for people traveling across and along Route 1.

Thus, this feasibility study aimed to provide sufficient information to make the best decision on a future project on Route 1 to meet transportation needs with the coming of Amazon and other related development. To this end, the study examined converting Route 1 to an at-grade urban boulevard or an elevated Sector Plan urban boulevard, as well as improving the existing elevated roadway from 12th Street S to 23rd Street S.

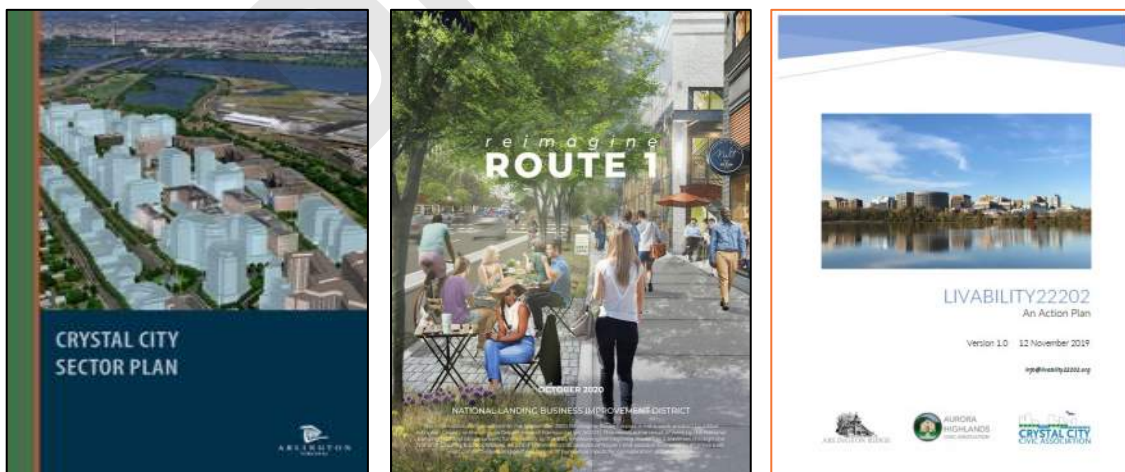
The goals of this study and a future Route 1 multimodal improvements project are as follows:

1. **Safety** – improve multimodal safety for pedestrians, bicyclists, micro mobility modes, transit, and vehicles along and across Route 1
2. **Multimodal Accessibility and Accommodation** – increase multimodal accessibility and accommodation along and across Route 1 – pedestrians, bicycles, transit, vehicles (and any other mode)
3. **Transit Effectiveness** – make transit more accessible, reliable, and convenient
4. **Vehicular Operations** – maintain an appropriate level of vehicular operation and accommodation along Route 1 and on intersecting streets—15th, 18th, 20th, and 23rd Streets S
5. **Environmental** – preserve, protect, or enhance the built, natural, visual, and social environments
6. **Urban Fabric** – integrate Route 1 with the urban fabric of Crystal City and Pentagon City as a multimodal urban boulevard design consistent with context of the surrounding existing and future built environment

These goals provided the basis for the development of measures of effectiveness (MOEs), which are defined and discussed in Chapter 2. The VDOT study team used the MOEs for the evaluation of possible Route 1 urban boulevard at-grade and grade-separated scenarios.

### 1.3. Guiding Documents

To achieve safety, multimodal connectivity, and the other goals of this project, this study builds upon the following documents to guide the study in achieving “improve safety, accessibility, and the pedestrian experience crossing Route 1”:



- **Crystal City Sector Plan:** This consensus-based land use and transportation plan, approved by the Arlington County Board in 2010, lays out the community’s vision to transform Crystal City into a more inviting, lively, and walkable community. The plan includes the transformation of Route 1 into an urban boulevard linking Crystal City’s east

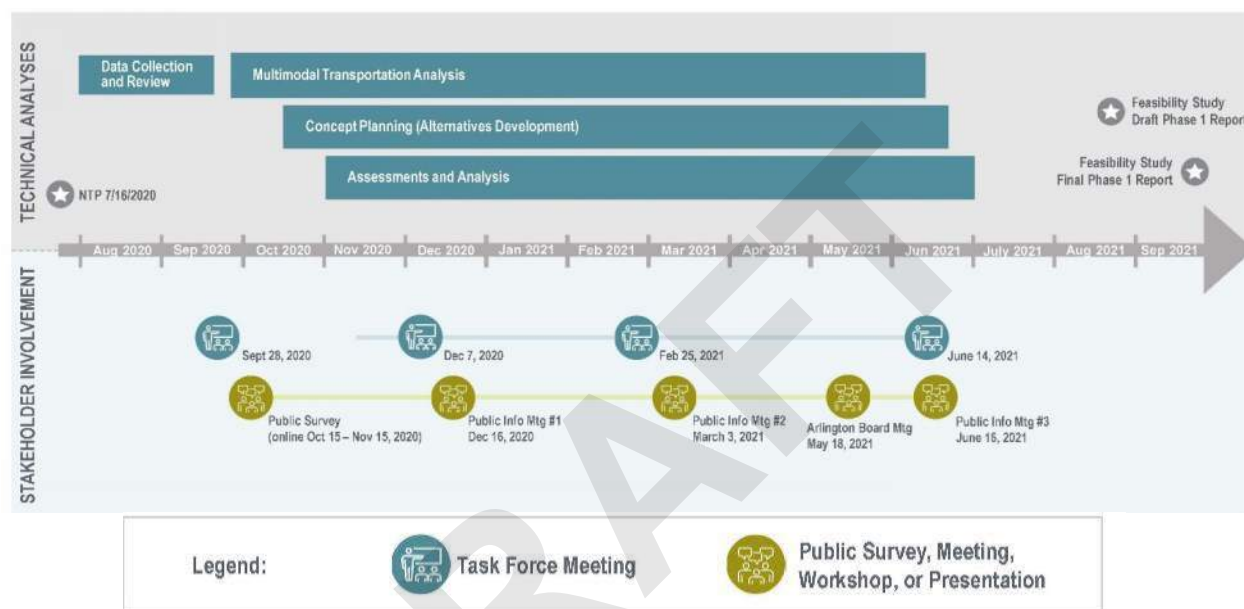
and west neighborhoods, with specific improvements to Route 1 between 12th Street S and 20th Street S and a vision for a Route 1 with land uses fronting the street.

- **Reimagine Route 1:** This document, published in September 2020 by the National Landing Business Improvement District (BID), lays out a “bold vision” to “transform Route 1 into a multimodal, pedestrian-friendly, and urban-oriented boulevard that unifies the area into a truly walkable, connected, urban downtown.” The purpose of this document was to share the BID’s perspective in the ongoing Route 1 planning efforts.
- **Livability 22202 Action Plan:** This plan, developed by representatives of Arlington Ridge, Aurora Highlands, and Crystal City Civic Associations, documents shared values and goals to achieve a better, more livable neighborhood as Pentagon City and Crystal City go through extensive redevelopment. Key priorities of this plan relative to VDOT’s Route 1 study are:
  - Fostering environmental sustainability, including strategically increasing the amount of natural open space and improving tree canopy, as well as incorporating biophilic design elements into built environments
  - Extending the multimodal transportation network, including the objective to “design and implement better and safer connections across Route 1.”
- **National Trends and State and Local Plans:** There are a number of national trends with respect to reconfiguring urban freeways (including making restitutions for projects built in the 1950s and 1960s that adversely impacted under-represented populations at the time).
  - **National:** Of note is the research by the Congress of the New Urbanism in the form of *Freeways without Futures*, a document detailing ongoing freeway removal projects across the US. See also the discussion in Chapter 7 of this report comparing this proposed Route 1 project to similar projects in the US.
  - **State:** VDOT and the Commonwealth of Virginia have multiple recent plans and initiatives which have informed this effort, including the VDOT Pedestrian Safety Action Plan (PSAP) and Virginia Strategic Highway Safety Plan (SHSP). SHSP emphasis areas include speed, intersections, bicyclists, pedestrians, and more, and this plan stems from Virginia’s commitment toward zero deaths for roadway users.
  - **Local:** Arlington County has been on the forefront of state-of-the-practice policies on implementing multimodal improvements. Of note, the various elements of Arlington’s *Master Transportation Plan* have provided guidance for this study, as has the recent adoption of a *Vision Zero Action Plan*, which “demonstrates Arlington’s commitment to achieve zero transportation-related deaths and serious injuries on our streets and trails by 2030.”

Together, these documents provide a vision for National Landing to help achieve with a Route 1 project. These documents and others are cited in **Appendix A, References**, and the application of these guiding documents is discussed in Chapter 6, Concept Development.

## 1.4. Study Scope and Schedule

The scope of this study of Route 1, from 12th Street S to 23rd Street S, explores the feasibility of an at-grade urban boulevard in comparison with potential improvements to the current elevated condition and the urban boulevard described in the Sector Plan. The elements of this scope are shown in **Figure 1-1**, including the technical analyses and related tasks, as well as the stakeholder involvement milestones, along with the overall timeline. Future study tasks are described in Next Steps at the end of this report.



**Figure 1-1 Study Tasks and Schedule (Phase 1)**

Referring to **Figure 1-1**, this study began with data and document collection and review in the summer of 2020 and moved into the technical tasks of multimodal transportation analyses, including a safety analysis, existing conditions analysis, future conditions analysis without Route 1 multimodal improvements, and a future build conditions analysis. The concept planning, assessments, and feasibility analyses tasks included plan and profile studies, an examination of street cross sections and alignments, development of alternatives, and assessments of constructability, multimodal mobility, stormwater management strategies, and redevelopment potential.

Stakeholder involvement for Phase 1 first included an online survey in the fall of 2020 and then a series of Route 1 Task Force meetings and public information meetings (PIMs) on the dates shown in **Figure 1-1**. Thus, this report has relied on the input of the many members of the Task Force and the many participants in the three Public Information Meetings. The Stakeholder involvement process and the input received for this Phase 1 report is summarized in Chapter 5 of this report.

## 1.5. Report Overview

This report discusses the feasibility analyses conducted in the Route 1 Multimodal Improvements Study, which examined various at-grade configurations, the elevated urban boulevard configuration from the Sector Plan, and lower-cost improvements to the existing elevated highway. Findings are discussed and conclusions are drawn in this Phase 1 study, setting up additional study in Phase 2 that is needed to address pedestrian safety concerns raised by stakeholders and to develop a multimodal travel demand strategy, including the development of a multimodal transfer center near the Crystal City Metrorail Station that aims to reduce future traffic volumes and allow convenient access to other modes of transportation.

DRAFT

## 2. Project Context and Study Methodology

This chapter discusses the history of Route 1 and the state of Route 1 today as context for this multimodal transportation study. The study methodology is also summarized, including study areas, analysis tools, and measures of effectiveness (MOEs) used to compare the various conceptual urban boulevard configurations developed with this study.

### 2.1. History of Route 1 in Crystal City

The segment of Route 1 in Crystal City is part of historic US Route 1 that traverses the East Coast of the United States from Key West, FL to Fort Kent, ME, a length of 2,370 miles. As US 1 evolved from 1920s to the early 1960s, the segment of Route 1 in Crystal City served the evolving land uses of that time—industrial sites, motels, and even a drive-in theater near 20th Street S.



*Route 1 in March 1962 (Aerial Photo Courtesy of Arlington County)*

In the mid-1960s, more deliberate residential and commercial development began in Crystal City, with the construction of the Crystal House and other condominiums as well as office buildings. Crystal City's underground shopping mall opened in 1976 to national acclaim. All of these land uses were served by ample vehicle parking and a network of one-way local streets.

In the mid-1970s, two major regional transportation projects were constructed in the Route 1 corridor that have had a lasting impact:

- The region's new Metrorail system added stations in Crystal City and Pentagon City, both of which opened in 1977 and were the catalysts for TOD.



*Crystal City Metro Construction, 1970s  
(photo courtesy of "Greater Greater Washington")*

- The interchange of Route 1 with I-395 was reconstructed, which included a proposed urban freeway spur to be designated as I-595 to connect I-395 with the access road to National Airport. Ultimately, the entire spur was not constructed due to local opposition, but portions of the spur were constructed and opened in 1987: the at-grade intersection at 15th Street S was converted to a diamond interchange and the at-grade intersection at 18th Street S was converted to an overpass.

During the past 30 years, and especially the past 10 years, with the guidance of the Sector Plan, the network of local streets in Crystal City has evolved to support the evolving land uses and to support the desire on the part of Arlington County and its citizens to have complete streets—the public realm or street space between buildings that supports wide sidewalks, street trees and lighting, on street bicycle lanes, protected bicycle lanes, cycle tracks, high-visibility cross walks, and numerous bus transit stops, as well as vehicles and buses. The county also has constructed multimodal access to the Metrorail station with sawtooth bus bays along 18th Street S, and the county has converted the one-way streets to two-way travel for easier wayfinding for all modes and for better visibility of retail businesses.



*Route 1 Corridor in Crystal City Circa 2006*

## 2.2. Route 1 Today

Today, Crystal City and Pentagon City continue to evolve from auto-centric developments to higher-density, urban places that people can access by a variety of modes—walking, biking, scooters, public transit, or driving—and Arlington County’s network of local streets is evolving to better accommodate multiple transportation modes. However, Route 1 has essentially stayed the same since the construction of the truncated I-595 project in the mid-1980s.



*Route 1, Looking North From 23rd Street S (March 2020)*

It is anticipated that Route 1 in Crystal City will continue to serve travelers who use the road as a regional highway to access Washington, DC, and the Rosslyn-Ballston Corridor to the north or the City of Alexandria and Fairfax County to the south, as well as those travelers who use the road for access to destinations in Crystal City and Pentagon City.

It also is anticipated that regional travel by other modes can and will increase through the following efforts:

- The introduction of Metrorail with stations in Crystal City and Pentagon City in the 1970s provided travelers a robust travel choice in lieu of using Route 1.
- Metrorail system capacity improvements are planned, as is a second entrance to the Crystal City Metro Station.
- VRE also is making capacity improvements, including relocating their station on the east side of Crystal City to be more accessible to Metro and other modes near 18th Street S.
- Arlington County has introduced high-quality, frequent bus service in the form of the Crystal City Potomac Yard (CCPY) Transitway—the Metroway—with its dedicated bus lanes, and the county and the Washington Metropolitan Area Transit Authority (WMATA) continues operate numerous Arlington Transit (ART) and Metrobus bus transit routes.
- The county also has also installed dedicated bike lanes and implemented other bike and pedestrian safety and access improvements.
- Along with these transportation changes, land owners have been redeveloping parcels within Crystal City and Pentagon City—including bringing the fronts of buildings to the streets, making them more accessible to the sidewalks, and offering a mix of uses, including residential, office, and retail. The developers also are improving the sidewalks, landscaping, streetscape, and even the streets themselves in front of their buildings.
- Arlington County’s multimodal transportation policies and requirements for new developments to limit parking and implement a travel demand management plan.

Many of the recent land use and transportation changes have been guided by the Sector Plan. The Sector Plan was accompanied by the *Crystal City Multimodal Transportation Study*, and its many recommendations for implementing a program of complete streets—streets that provide multiple travel choices and are designed in the context of their adjacent land uses, especially as those land uses evolve. Many of the county’s complete streets projects have been completed or are underway, including the two-way conversion of Crystal Drive and taking down the elevated portions of South Clark-Bell Street to make those corridors more bike- and pedestrian-friendly.

One result of these land development and transportation changes has been a dramatic increase in non-auto mode share—people are choosing to walk, bike, and take transit instead of driving their personal vehicles. These travel choices will benefit the development of the Route 1 Multimodal Improvements project. Indeed, Route 1 is a key component of the Sector Plan. The longer-term objective for Route 1 is to remove what is perceived as an east-west barrier within Crystal City and convert the highway portion of this road to an at-grade, urban boulevard. Such a conversion would result in wider sidewalks, landscape buffers with street trees, and an appropriate number of travel lanes to serve vehicles and transit. Converting Route 1 to an urban boulevard also would provide the opportunity for adjacent buildings to front the streets—for redevelopment projects to embrace Route 1/Richmond Highway at their front door.



**People on Scooters Crossing Route 1 at 20th Street S**

With the establishment of Amazon’s HQ2, bringing more than 25,000 jobs to the area and the development of the Amazon campus, both Amazon and Arlington County have committed to providing robust non-auto mode travel choices—with a goal of just 30 percent of person trips generated traveling by automobile.

The Crystal City BID has been actively supporting these land use changes. In addition to growing its membership to include developments in Pentagon City and Potomac Yard, the BID recently published its *Area-Wide Strategic Plan* through its Future Cities project. One of the major initiatives of the plan is to transform Route 1, “unifying east and west by transforming Route 1 into an urban boulevard.” The BID’s plan states that “Transforming the roadway into a multimodal, pedestrian-friendly, and urban-oriented boulevard presents the largest and most comprehensive opportunity to create a truly walkable, connected, urban downtown.”

With the Commonwealth’s commitment to convert Route 1 into an urban boulevard—supported by the planning and implementation efforts of Arlington County—VDOT is moving forward with the necessary transportation analysis and engineering study for this conversion. It is understood that some stakeholders are concerned about the potential diversion of regional traffic onto local

streets and other regional routes during and after construction. This study addresses this concern, and VDOT will continue to work with stakeholders on solutions that include TDM strategies and the deliberate use of other travel modes that have resulted from robust investments by Arlington County and the Commonwealth of Virginia.

## **2.3. Study Methodology and Assumptions**

This Phase 1 study used existing available data sources to facilitate the transportation analyses across all modes within the Route 1 corridor—pedestrians, bicycles, transit, and vehicles. The procedures and assumptions for this Route 1 Multimodal Improvements Study followed an analysis methodology and design criteria which was agreed upon with Arlington County's Transportation Division, in coordination with their ongoing Pentagon City Planning Study, which is a separate from this Route 1 study.

The county's Pentagon City Planning Study is evaluating future land use scenarios in the area and pivoting from the County's 1976 Phased Development Site Plan (PDSP). The county's study will result in a draft Pentagon City PDSP Update Planning Study Plan, which will be vetted with the public and is expected to convey new land use policies, redevelopment principles, and supporting urban design guidelines for future growth within Pentagon City.

As part of their study, Arlington County has developed and calibrated transportation analysis models that encompass nearly the entire Route 1 study area and contain existing peak period traffic volumes and signal timings. Thus, for the Route 1 Multimodal Improvements Study, VDOT made use of these existing models and of previously collected traffic data to have consistency between the VDOT's and Arlington County's studies, as well as overcome challenges in any data collected during the COVID-19 pandemic.

### **2.3.1. Concept Planning Study Area**

The study area for developing concepts for Route 1 multimodal improvements shown in **Figure 2-1** and extends along Route 1 from 12th Street S to 23rd Street S and includes those relatively short segments of 20th, 18th, and 15th Streets S that are influenced by their interfaces with Route 1. This area was the focus of the concept design and evaluation.

### **2.3.2. Transportation Analysis Study Area**

Recognizing that changes to Route 1 may influence the broader transportation network, the multimodal transportation analysis study project study area, as shown in **Figure 2-2**, included Route 1 between the I-395/Route 110 interchange and the Washington National Airport Access Road (Route 233) interchange, inclusive of the interchanges and intersections along this segment of Route 1. The analysis study area also included the parallel north-south Arlington County streets of S Fern Street, S Eads Street, S Clark Street, S Bell Street, and Crystal Drive, as well as the overlapping east-west Arlington County streets of 12th Street S, 15th Street S, 18th Street S, 20th Street S, and 23rd Street S. The signalized and unsignalized intersections and the interchanges along these streets were included in the study area, as well as associated sidewalks and bicycle facilities.

Referring to **Figure 2-2**, there are three study area sub-designations along Route 1:

- **Core Street Study Area** – this area is the concentrated street network that is the focus of the reconfiguration alternatives and concept designs. This area had the most detailed multimodal analysis (shown in dark blue).
- **Vissim Operational Analysis Area** – this area was the focus of Vissim operational analyses that were conducted (shown in light blue).
- **Synchro Operational Analysis Area** – this area was the focus of Synchro operational analyses conducted for this study (shown in orange).



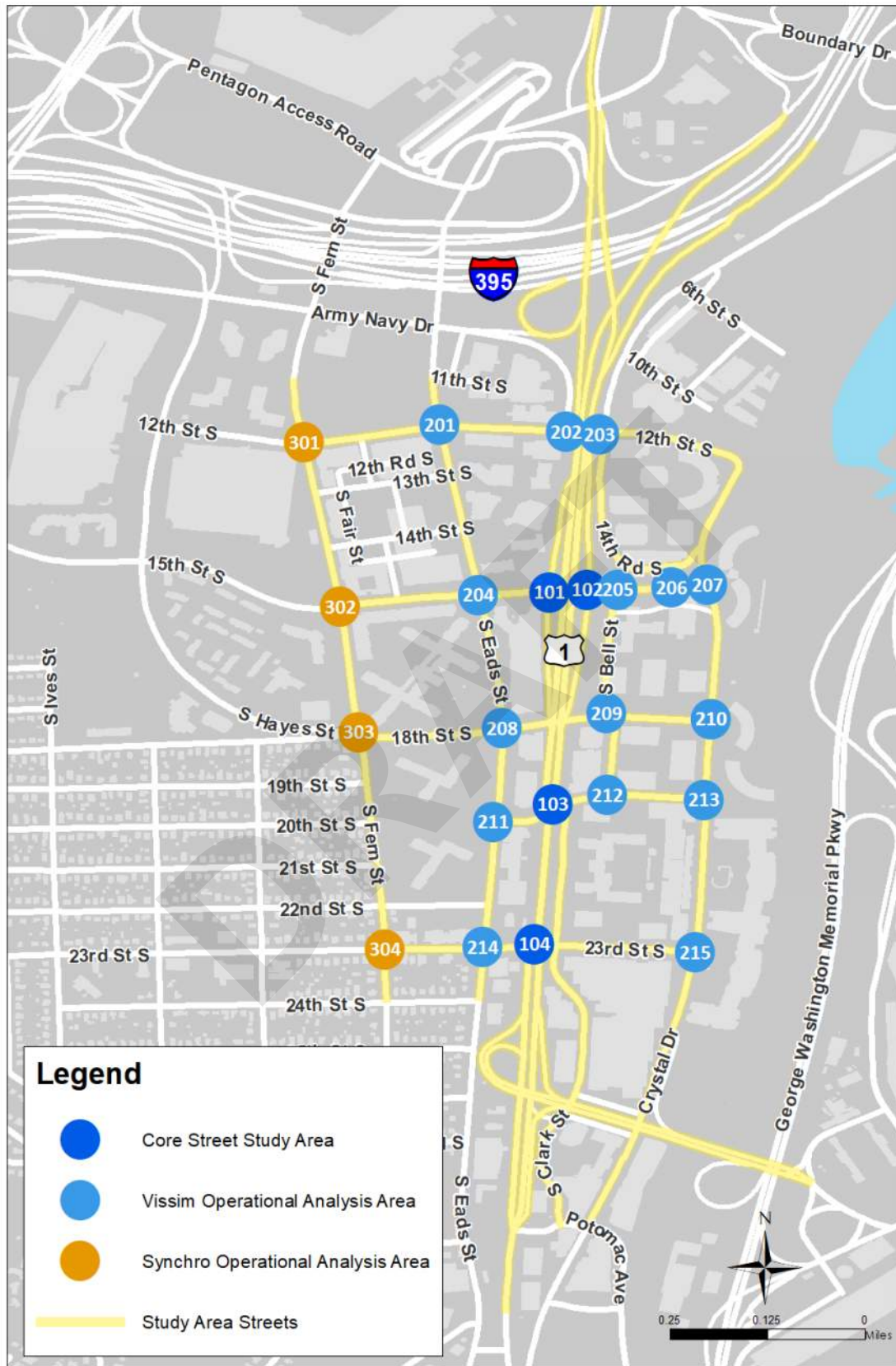
**Figure 2-1 Concept Planning Study Area**

For analysis purposes, the following interchanges were included in the project study area:

- Route 1/I-395/Route 110 – note that only the following south-facing ramps were included:
  - Southbound I-395 to southbound Route 1
  - Northbound Route 1 to northbound I-395
  - Southbound Route 110 to northbound I-395
  - Southbound Route 110 to southbound Route 1
  - Northbound Route 1 to northbound Route 110
- Route 1/15th Street S
- Route 1/Route 233 (Airport Access Road), including the ramp from westbound Route 233 to northbound Crystal Drive

The following critical intersections were included in the multimodal transportation analysis study area. **Figure 2-3** illustrates the lane configuration of each of these intersections:

- 12th Street S
- S Fern Street
- 12th Street S/S Eads Street
- 12th Street S/Army Navy Drive
- 12th Street S/Long Bridge Drive/S Clark Street
- 15th Street S/S Fern Street
- 15th Street S/S Eads Street
- Southbound Route 1 ramps/15th Street S
- Northbound Route 1 ramps/15th Street S
- 15th Street S/S Bell Street
- 15th Street S/14th Road S (S Clark Street)
- 15th Street S/Crystal Drive
- 18th Street S/S Fern Street
- 18th Street S/S Eads Street
- 18th Street S/S Bell Street
- 18th Street S/Crystal Drive
- 20th Street S/S Eads Street
- Route 1 and 20th Street S/S Clark Street
- 20th Street S/S Bell Street
- 20th Street S/Crystal Drive
- 23rd Street S/S Fern Street
- 23rd Street S/S Eads Street
- Route 1 and 23rd Street S/S Clark Street
- 23rd Street S/Crystal Drive



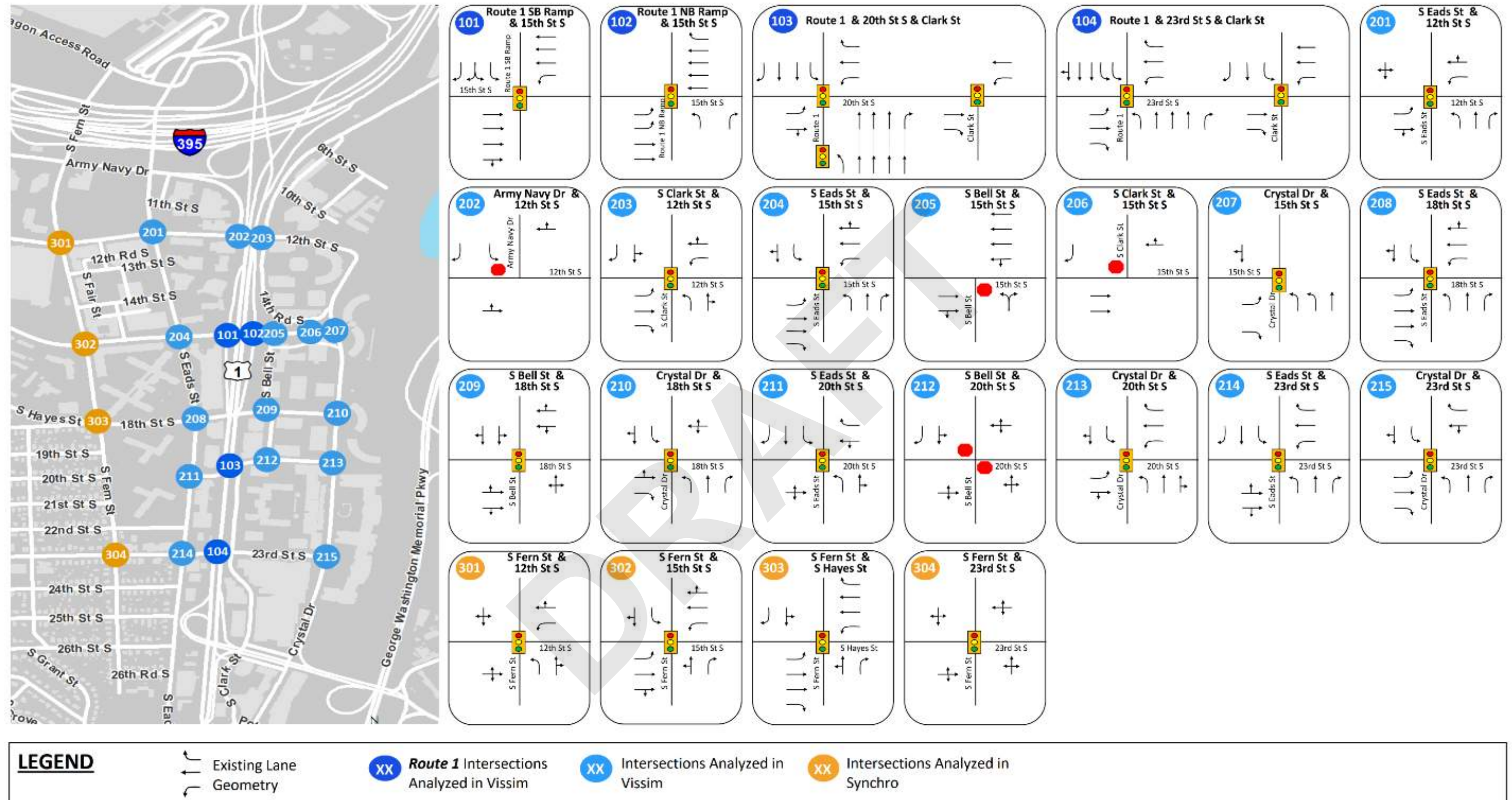


Figure 2-3 Existing Intersection Lane Configurations within Analysis Study Area

### 2.3.3. Measures of Effectiveness

In conducting the multimodal transportation analyses and developing and analyzing potential concepts, the VDOT study team applied measures of effectiveness (MOEs) to draw conclusions about potential urban boulevard configurations for Route 1. These MOEs are described below.

- **Safety (Crashes):** Quantitative comparison of concepts in the anticipated reduction in crashes
- **Walkability:** Qualitative measurement of pedestrian walkability and routing along and across Route 1. It should be noted that for an area to be “walkable,” as defined by Jeff Speck in *Walkable City*, a walk should be:
  - Useful, with most aspects of daily life close and organized
  - Safe, with streets designed to be safe and feel safe to pedestrians
  - Comfortable, with urban streets that act as outdoor gathering spaces
  - Interesting, with sidewalks lined by unique buildings with inviting facades
- **Bikeability:** Qualitative measurement of bicyclist ease of mobility and routing along and across Route 1
- **Transit Effectiveness:** Qualitative measurement of the ease of operations for transit vehicles and access, such as access to Metro and bus transit facilities, and potential congestion which could affect transit operations
- **Vehicular Traffic Operations:** Quantitative measurement of the traffic operations using the Vissim tool
- **Pedestrian Operation and Safety:** Quantitative and qualitative measurements of the pedestrian operations and delay at intersections through Synchro and Vissim, and pedestrian safety review based upon proposed design features such as median refuges and crosswalks
- **Shift-In Trips to Non-Auto Modes:** Quantitative and qualitative comparisons of the shift in trips from vehicular modes to non-vehicular modes such as Metro, bicycle, and pedestrian modes
- **Cost:** Quantitative analysis of the cost of the Route 1 multimodal improvement concepts as identified with this study
- **Constructability:** Qualitative and quantitative measurements of the difficulty and time associated with the construction of each of the conceptual scenarios given the constraints of the corridor and need to keep pedestrian, bicycle, and vehicular traffic moving at all times during construction.
- **Americans with Disabilities Act (ADA) considerations:** Quantitative measurement and analysis of the proposed design features with respect to compliance with ADA as compared to existing conditions.

- **Urban Fabric:** Qualitative review of the ability of the potential for a concept to fit into the context of the urban nature of Crystal City and to knit together the land uses and grid of streets
- **Redevelopment Potential:** Quantitative measurement of the amount of developable land which may become available as a part of the Route 1 multimodal improvements
- **Adaptability:** Qualitative measurement of the different urban boulevard concepts to adapt to changes that may take place in the future including additional development, reduced vehicular volumes, introduction of autonomous vehicles, and other future possibilities
- **Environmental Impacts:** Quantitative and qualitative measurements of the reduction in impervious area associated with each scenario along with the potential for aesthetic and social impacts resulting from each scenario
- **Maintenance:** Quantitative and qualitative reviews of the potential future maintenance costs and needs associated with the different scenarios, including roadway infrastructure, bridges, retaining walls, lighting, and traffic signal costs

## 2.4. Summary

The history of Route 1 in Crystal City provides a backdrop for what could be a possible future for this corridor. Today, in close coordination with Arlington County and with input from stakeholders and citizens, VDOT is helping Route 1 move toward that future with an analysis of various alternative concepts that aim to improve multimodal safety and accessibility along and across Route 1. The subsequent chapters of this report step through the analyses, the development of the concepts, and the findings that have led to VDOT's recommendation for an at grade urban boulevard, with further study needed to address stakeholder concerns and to determine an optimal path forward.

### 3. Existing Conditions

This section describes the existing conditions in the Route 1 corridor in Crystal City. Existing conditions were analyzed to establish a baseline for the analysis of future conditions, the development of multimodal improvements concepts, and the evaluation of the feasibility of those concepts. As discussed in the previous chapter, the infrastructure analysis project area (as shown in Figure 2-1) includes the segment of Route 1 from north of 23rd Street S to south of 12th Street S, as well as segments of 20th, 18th, and 15th Streets S that are influenced by their interfaces with Route 1. Referring to Figure 2-1, as well as the photos and figures within this section of the report, this existing segment of Route 1 is characterized by a geometry that focuses on accommodating vehicle movements. This segment exhibits a straight (tangent) alignment and a relatively smooth profile and with a posted 35-mph speed limit.

#### 3.1. Existing Geometric and Infrastructure Conditions

The VDOT study team evaluated existing geometric and infrastructure conditions on this Route 1 segment using the survey data provided by VDOT. The evaluation found both the horizontal and vertical geometry to be adequate, with no discernable horizontal curves and with vertical grades less than 3 percent, i.e., this segment of Route 1 was designed and constructed to be a higher-speed freeway. The evaluation of the vertical profile also confirmed that—with the 35 mph speed limit—there is adequate stopping sight distances at 20th Street S and 23rd Street S. The existing roadway geometry and supporting infrastructure are described below, including a discussion of existing cross sections; bridges, retaining walls, and subsurface structures; pavement and geotechnical conditions; drainage and stormwater management; utilities; and environment and urban form.

##### 3.1.1. Existing Cross Sections

The following existing cross sections were developed to understand how Route 1 and the side streets are currently making use of the space between existing buildings and other constraining features. Representative sample sections were developed between each of the crossing streets along Route 1 from 23rd Street S to 12th Street S. The side street cross sections were taken at 20th Street S, 18th Street S, and 15th Street S.

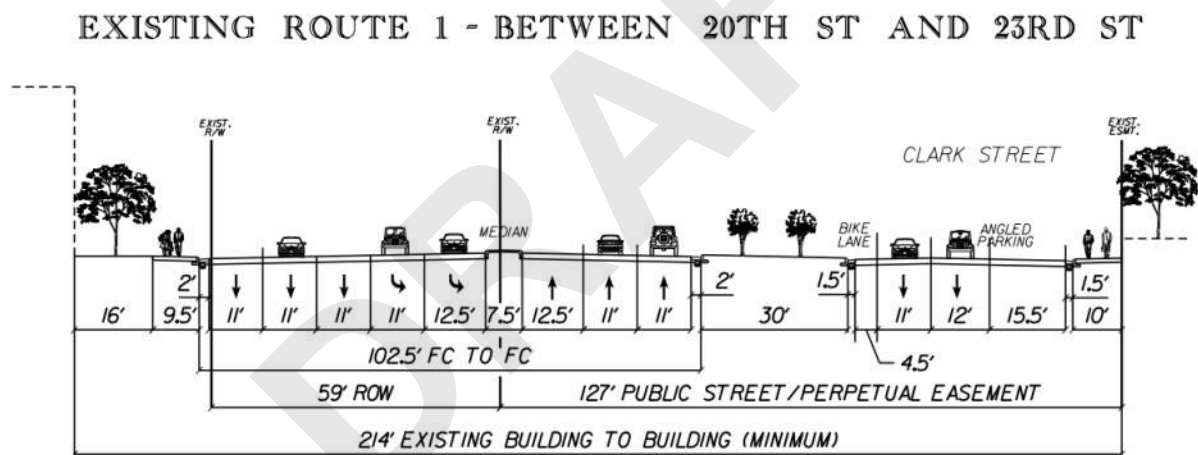
##### *Existing Route 1 – Between 23rd Street S and 20th Street S*

The photo below and **Figure 3-1** show the Route 1 cross section between 23rd Street S and 20th Street S. Notable features of this segment of Route 1 include:

- S Clark Street runs parallel to Route 1 and is very close to Route 1, separated only by a sidewalk and planted median/buffer.
- Southbound lanes include dual left turn lanes at 23rd Street S (which contribute to perceived pedestrian safety challenges)
- Wide sidewalks and roadway lighting exist on both sides of Route 1
- Transit stops are located on S Clark Street
- Building entrances generally front onto the corridor in this segment of Route 1



*Route 1 Looking North from 23rd Street S*



*Figure 3-1 Existing Route 1 Cross Section Between 23rd Street S and 20th Street S*

### **Existing Route 1 – Between 20th Street S and 18th Street S**

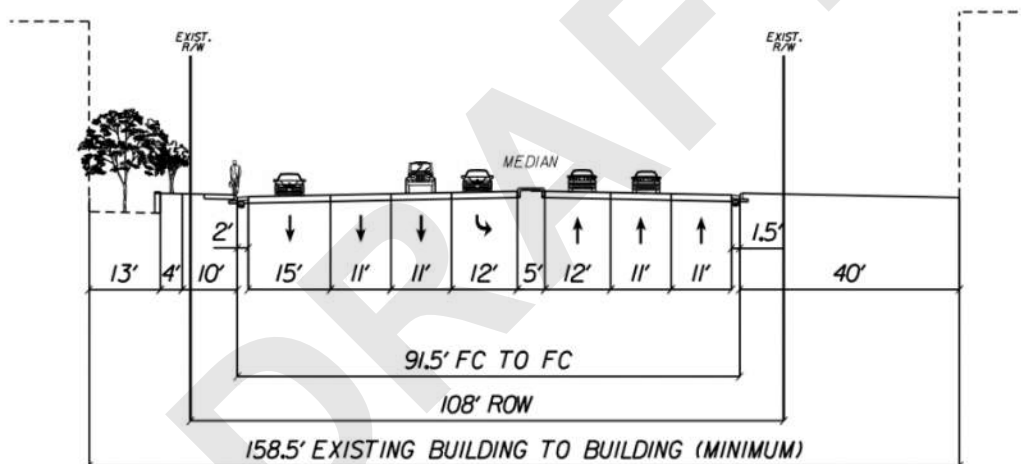
The photo below and **Figure 3-2** show the cross section between 20th Street S and 18th Street S. Features of this section include:

- Cross section is physically constrained due to existing buildings
- S Bell Street runs parallel to Route 1, on the east, with buildings in between
- There is no access to existing building entrances along Route 1; however, several buildings have doors that exit onto the Route 1 sides of their buildings
- Roadway lighting exists in the median, and some sidewalk and pedestrian lighting are present on the west side



*Existing Route 1 – Between 20th Street S and 18th Street S*

## EXISTING ROUTE 1 - BETWEEN 20TH ST AND 18TH ST



*Figure 3-2 Existing Route 1 – Between 20th Street S and 18th Street S Cross Section*

### **Existing Route 1 – Between 18th Street S and 15th Street S**

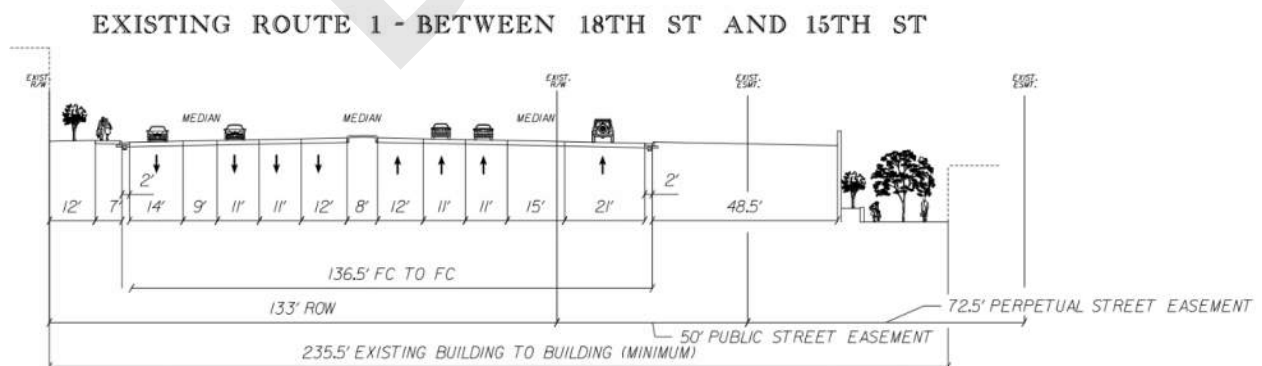
The photo below and **Figure 3-3** show the cross section between 18th Street S and 15th Street S. Features of this section include:

- Route 1 is elevated above adjacent land uses in this segment
- Crystal City Metro Station entrance constrains the cross section near 18th Street S
- The recent removal of the S Clark Street overpass by Arlington County on the east side provides additional space for future street elements and/or redevelopment
- S Bell Street runs parallel to Route 1, to the east, at a distance that may allow future redevelopment between the two roads
- Interchange ramps to/from 15th Street S occupy space within the cross section

- There is no access to existing building entrances along Route 1; however, several buildings have doors that exit onto the Route 1 sides of their buildings (e.g., Crystal Gateway Marriott emergency exit for its conference facilities are located along the on-ramp to Route 1 from 15th Street S)
- Roadway lighting existing on both sides of Route 1, and pedestrian lighting exists on the west (southbound) side
- A sidewalk exists on the west side, proceeding along the ramp from 15th Street S (below) to the bridge over 18th Street S; stairs exist to/from building exit doors along this sidewalk



*Existing Route 1 – Between 18th Street S and 15th Street S (Looking North)*



*Figure 3-3 Existing Route 1 – Between 18th Street S and 15th Street S Cross Section*

### **Existing Route 1 – Between 15th Street S and 12th Street S**

The photos below and **Figure 3-4** show the cross section between 15th Street S and 12th Street S. Features of this section include:

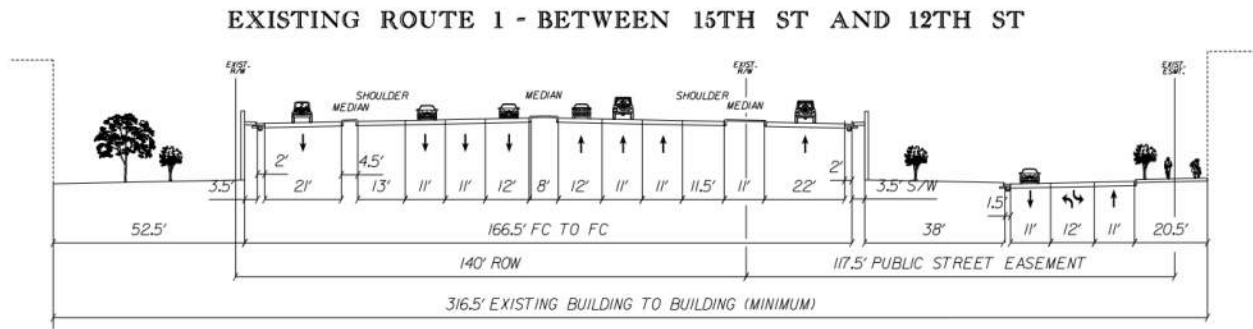
- Route 1 is an elevated freeway above adjacent land uses in this segment; of note is the former front entrance of the Americana Motel made inaccessible by the retaining wall of the elevated Route 1
- S Clark Street runs parallel to Route 1 on the east side
- There is no access to existing building entrances along the west side of Route 1; there are building entrances along the east side of S Clark Street
- Roadway lighting exists on both sides of Route 1



**Existing Route 1 – Between 15th Street S and 12th Street S (Looking North)**



**Existing Route 1 Between 15th Street S and 12th Street S (Looking South)  
(Note: Former Americana Motel at right)**



**Figure 3-4 Existing Route 1 – Between 15th Street S and 12th Street S Cross Section**

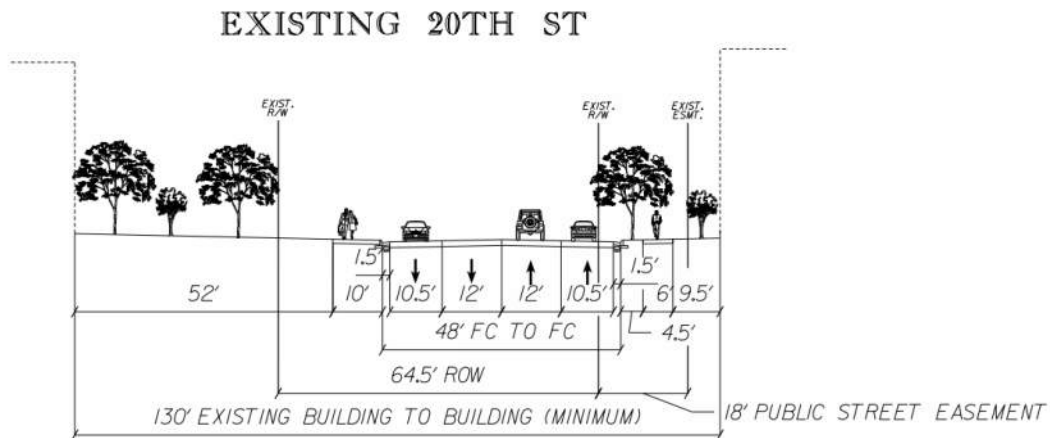
### Existing 20th Street S

The photos below and **Figure 3-5** show existing 20th Street S at Route 1. Features of this section include:

- Section is located on a segment of 20th Street S between two closely spaced signals at Route 1/20th Street S and S Eads Street/20th Street S
- Sidewalks and roadway lighting exist on both sides of 20th Street, with pedestrian lighting on the right (north) side



**Route 1 at 20th Street S**



**Figure 3-5 Existing 20th Street S Cross Section (Looking East Toward Route 1)**

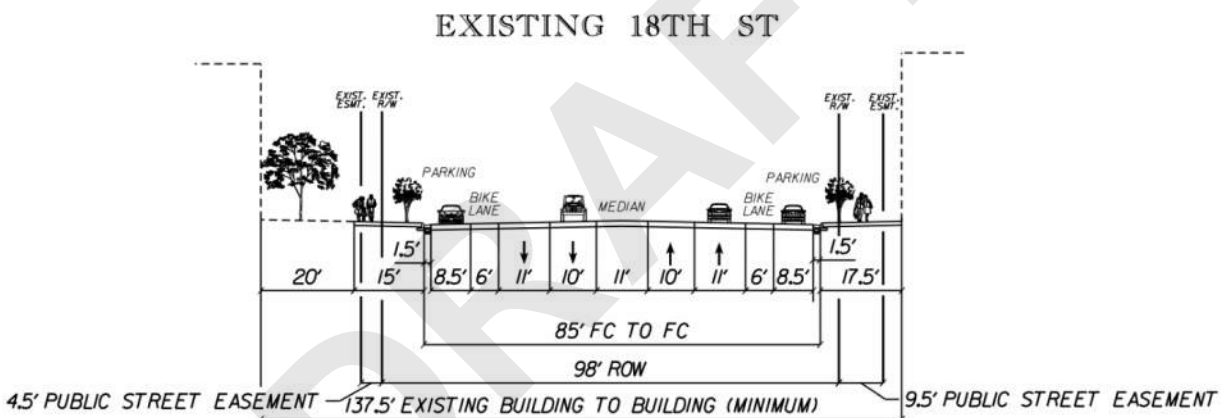
### Existing 18th Street S

The photo below and **Figure 3-6** show existing 18th Street S, just west of Route 1. Features of this section include:

- 18th Street S crosses under existing Route 1
- There are existing bus stops with saw tooth curbs located along 18th Street, below Route 1
- Roadway and pedestrian lighting exist on both sides of 18th Street S
- There are striped and painted (solid green) bike lanes in each direction
- Sidewalks greater than 6 feet wide exist on both sides of 18th Street S



**18th Street S Looking West From Route 1 Bridge to S Eads Street Intersection**



**Figure 3-6 Existing 18th Street S Cross Section (Looking East Toward Route 1)**

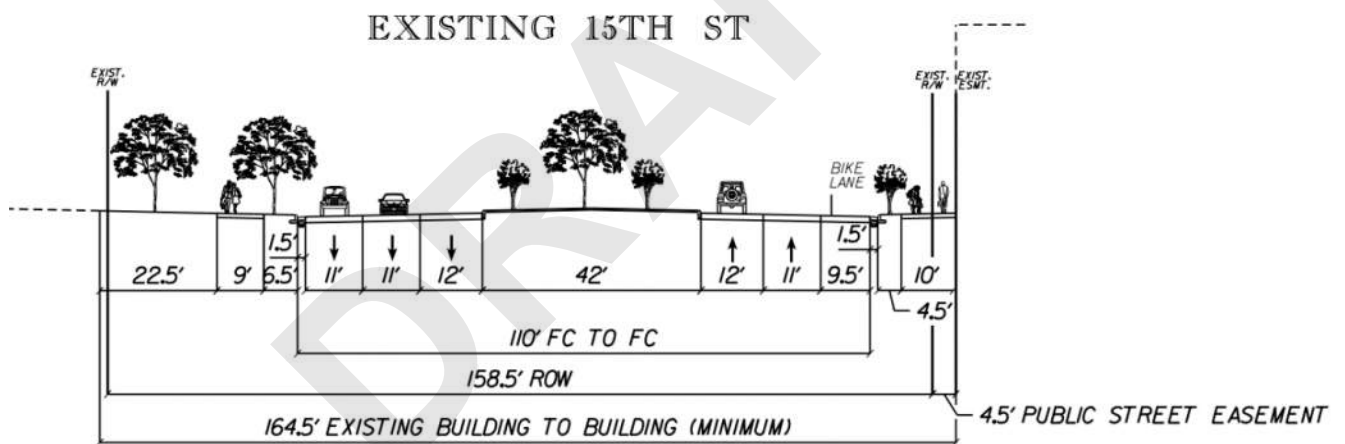
### Existing 15th Street S

The photo below and **Figure 3-7** show the cross section along 15th Street S, just west of Route 1. Features of this section include:

- 15th Street S crosses under existing Route 1
- There is an existing buffered bike lane on the south (eastbound) side but no bike facility on the north (westbound) side
- Roadway lighting exists on both sides of 15th Street S
- Sidewalks greater than 6 feet wide exist on both sides of 15th Street S, with marked pedestrian crossings at each of the ramps to/from Route 1



*15th Street S Looking East Toward Route 1 Bridge*



*Figure 3-7 Existing 15th Street S Cross Section (Looking East Toward Route 1)*

### 3.1.2. Existing Bridges, Retaining Walls, and Subsurface Structures

Existing structures along the Route 1 corridor were evaluated based on information in the bridge inspection reports provided by VDOT and based on observations in the field. The 18th Street S, 15th Street S, and 12th Street S bridges were determined to range from fair to good condition. Table 3-1 summarizes the existing conditions of these bridges. A detailed evaluation of the bridges and associated retaining walls is included in **Appendix B-1, Route 1 Feasibility Analysis Summary**.



*Existing Route 1 Bridge Over 18th Street S*

*Table 3-1 Summary of Existing Structures Condition*

Structure	Deck Rating	Superstructure Rating	Substructure Rating	Minimum Vertical Clearance
Route 1 Over 18 <sup>th</sup> Street S	6	7	6	14'-4"
Route 1 Over 15 <sup>th</sup> Street S	6	7	6	16'-3"
Route 1 Over 12 <sup>th</sup> Street S	7	6	5	17'-3"

**Notes for Table 3-1:**

1. A rating of 5 indicates Fair Condition; 6 indicates Satisfactory Condition; 7 indicates Good Condition. The highest possible rating is 9.
2. Associated wingwalls and retaining walls for each bridge are in generally good condition.
3. Table data based on available inspection reports from 2018 and 2020

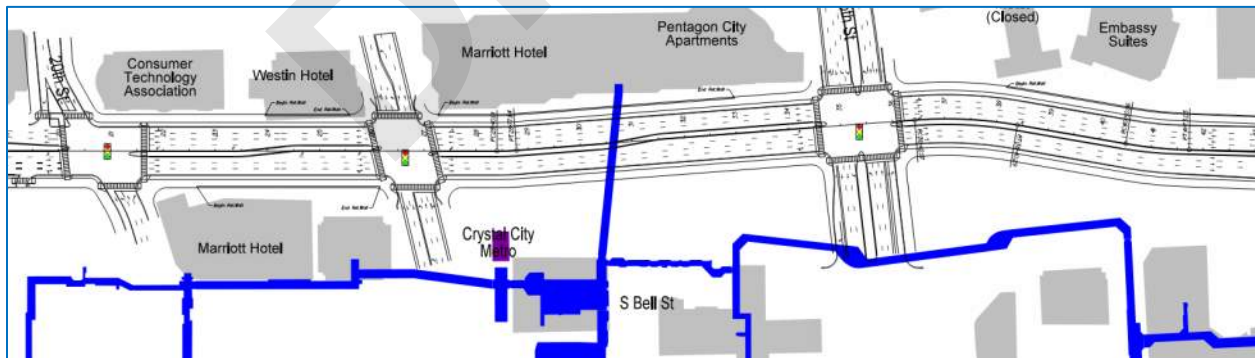
It should be noted that the Route 1 bridges over 18th Street S and over 15th Street S do not meet today's vertical clearance standards of 16 feet, 6 inches. The bridge over 18th Street is clearly substandard and can present challenges for delivery trucks and other oversized vehicles. In addition, the piers for these bridges limit the natural light getting to the sidewalks and bike lanes under these bridges. Thus, opportunities exist with any potential reconstruction of these bridges to build new single-span bridges that could provide more natural light for the underpasses.

Along with VDOT's bridges and retaining walls, WMATA operates and maintains the Crystal City Metro station and Metro tunnels in the study area. The Crystal City Metro station has escalator and elevator entrances at the intersection of 18th Street and S Bell Street. The Metro tunnel (for the Yellow and Blue Lines) runs underneath 18th Street in the study area and has a ventilation shaft that extends from the underground tunnel vertically up to the sidewalk along 18th Street at the Route 1 bridge abutment, as shown in the photo at right.



***Metro Tunnel Vent in Sidewalk Along 18th Street S Under Route 1***

Other subsurface structures within the influence area of a reconstructed Route 1 in Crystal City include private parking garages under most buildings in the corridor, as well as the Crystal City Underground, the shopping mall that opened in 1976 and remains a retail center today as the Crystal City Shops. Primarily on the east side of Route 1, the shops are connected by an extensive network of pedestrian walkways that are approximately one level below 15th and 18th Streets. These walkways also connect various buildings in the area. One of these underground walkways extends under existing Route 1 just north of 18th Street S, connecting the first floor of the Marriott Crystal Gateway Hotel on the west to the Crystal City Shops on the east, near the mezzanine entrance to the Crystal City Metro station. **Figure 3-8** shows a schematic of this pedestrian tunnel in relation to an at-grade Route 1 urban boulevard concept.



***Figure 3-8 Diagram of Underground Pedestrian Walkways Connecting Crystal City Shops***

### 3.1.3. Existing Pavement and Geotechnical Conditions

The streets in the project corridor are paved with asphalt cement concrete. Sidewalks are generally paved with hydraulic cement concrete. Asphalt and concrete pavement thicknesses and roadway subgrade information were not available for this study; any future design will need to first collect this pavement data before moving forward with pavement design recommendations. Based on Google Earth imagery and site visits, minor pavement distresses

such as longitudinal and transverse cracking are visible on roadway pavement surfaces. A few major pavement distresses such as potholes and rutting are also present within the project area. Several sidewalk areas are in need of maintenance and repair.

Regarding the soils in the study area, the study team collected and reviewed existing geotechnical conditions information to understand the expected subsurface conditions at the existing structures, pavements, and embankment slopes along Route 1 from 23rd Street S to 12th Street S. From the data review and site observations, it is evident that there will be challenges with demolition and/or reconstruction at the 18th Street S bridge due to the existing building foundations located adjacent to the structure and retaining walls. The documentation also indicated the possible presence of unsuitable soils near 12th Street S and 15th Street S that will need to be removed or mitigated, as well as the presence of subsurface water. Additional information and discussion items are included in **Appendix B-1, Feasibility Analysis Summary** and **Appendix B-2: Route 1 Existing Geotechnical Conditions Memo**.

#### **3.1.4. Existing Drainage and Stormwater Management**

Existing drainage and stormwater management facilities in the Route 1 corridor were reviewed based on the existing conditions survey data provided by VDOT and on observations from multiple site visits. The proposed Route 1 Multimodal Improvements project is located within the Roaches Run watershed, also known as the Potomac River Pimmit Run watershed (HUC 020700100103). There are four primary manmade outfalls identified along the project corridor. All four outfalls eventually flow into the Potomac River. The outfalls are as follows:

- 8-foot by 8-foot box culvert, crossing Route 1 between 15th Street S and 12th Street S
- 24-inch pipe, draining east down 15th Street S
- 36-inch pipe, draining east down the northside of 23rd Street S
- 36-inch pipe, draining east down the southside of 23rd Street S

There were no existing stormwater management facilities identified in the existing conditions survey treating runoff from the public right-of-way. The street infrastructure in the area was mostly constructed in the 1980s before the current stormwater management regulations were in place. Existing stormwater management facilities located on private property were not included in the survey provided; such stormwater management facilities may not be adequate or even exist depending on the date of the development. Additional information on existing stormwater management is discussed in **Appendix B-3, Route 1 Stormwater Management Assessment**.

### 3.1.5. Existing Utilities

The Route 1 right-of-way contains a full range of utilities as expected in an urban area. The existing conditions survey identified natural gas, water, sanitary sewer, storm sewer, electric duct banks, and communications duct banks—all located underground. (The existing traffic control and streetlight utility lines were not identified in the underground survey.) The existing utilities are generally concentrated on the east side of the Route 1 corridor and mostly remain outside of the existing Route 1 roadway pavement, as shown in **Figure 3-9**. Many utilities remain in the former alignment of Clark Street S. There appears to be an abandoned 6-inch gas line located on the west side of Route 1.



*Fire Hydrant at Route 1/20th Street Intersection with Markings of Multiple Underground Utilities*

The side streets of 20th, 18th, and 15th streets S also appear to have a concentration of utilities within their rights-of-way. Based on the age and history of the corridor, it should be assumed that abandoned or unidentified utilities will likely be discovered through additional utility surveys or during construction.



*Figure 3-9 Existing Utilities in the Route 1 Study Corridor*

### 3.1.6. Existing Environment and Urban Form

Crystal City is a unique built environment initially created in the 1960s with access primarily designed for the automobile, as indicated by the many existing parking garages. As the

Metrorail system developed, with a station constructed in the heart of Crystal City, the built environment has more recently reflected development that can be accessed more easily by non-automobile modes. Indeed, travel options have increased for access to and through Crystal City with a robust network of sidewalks, on- and off-street bicycle facilities, and a robust transit network, including numerous bus transit options.

The current configuration of the Route 1 corridor from 23rd Street S to 12th Street S was constructed in the mid-1980s as part of a regional highway project that was truncated due to public opposition to a longer limited access elevated freeway. Over the past three decades, the corridor has evolved as private landowners have developed parcels adjacent to Route 1 and as Arlington County has implemented multimodal street improvements outlined its 2010 Sector Plan.

Along with this built environment, the county and private landowners have enhanced the natural, visual, and social environments in the vicinity of the study area with the following projects:

- Construction of Long Bridge Park and its playing fields, passive recreation space, and esplanade which enhanced pedestrian and bicycle trail connectivity in the area;
- Reconstruction of Crystal Drive with business-friendly two-way traffic and with more robust transit and bicycle facilities and wider sidewalks with room for restaurant seating;
- Deconstruction of auto-centric facilities such as the S. Clark Street bridges over 15th Street S and 18th Street S to provide opportunities for redevelopment and open space

The built, natural, visual, and social environments all combine to create the evolving urban form that exists today within the Route 1 corridor. As shown in the photos below, there are opportunities to improve this environment with a conversion of existing Route 1 to a multimodal urban boulevard designed in the context of the existing and planned urban form.



*Americana Motel (March 2020) with Front Entrance Altered by Elevated Route 1 in the Mid-1980s*



*Existing Buildings with Their Backs (and Emergency Exits) Along Route 1 Onramp from 15th Street S*



*S Clark Street Demolition, March 2020 – Arlington County Project Removed Elevated S Clark Street, Creating Opportunity for Multimodal Solutions and/or Redevelopment That Will Front Route 1*



*Nearby Long Bridge Park (Phase I completed in 2011) Enhances Built, Natural, Visual, and Social Environments in the Route 1 Corridor*

### 3.2. Historic Vehicle Traffic Counts

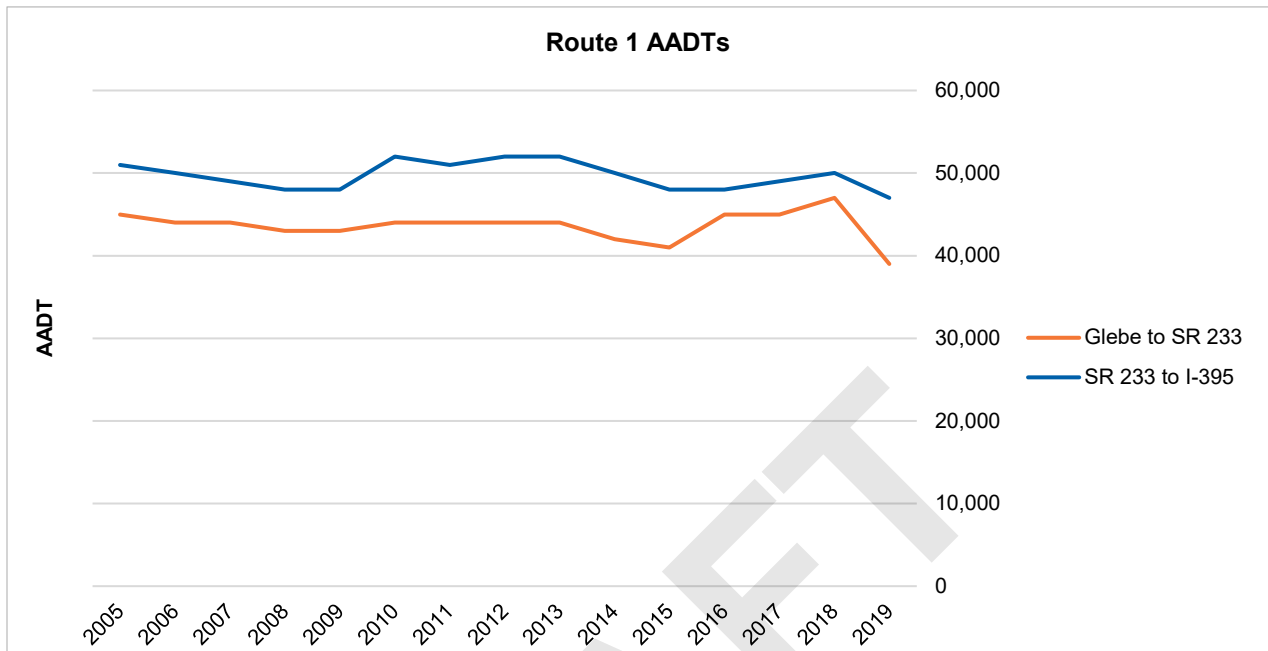
VDOT compiles traffic count estimates for roadways throughout the Commonwealth each year<sup>1</sup>.

**Figure 3-10** provides a plot of annual average daily traffic (AADT) by year along two segments of Route 1 in south Arlington. **Figure 3-11** provides a plot of AADTs by year along various cross streets in the study area. **Figure 3-12** provides a plot of AADTs by year along streets running parallel to Route 1 in the study area.

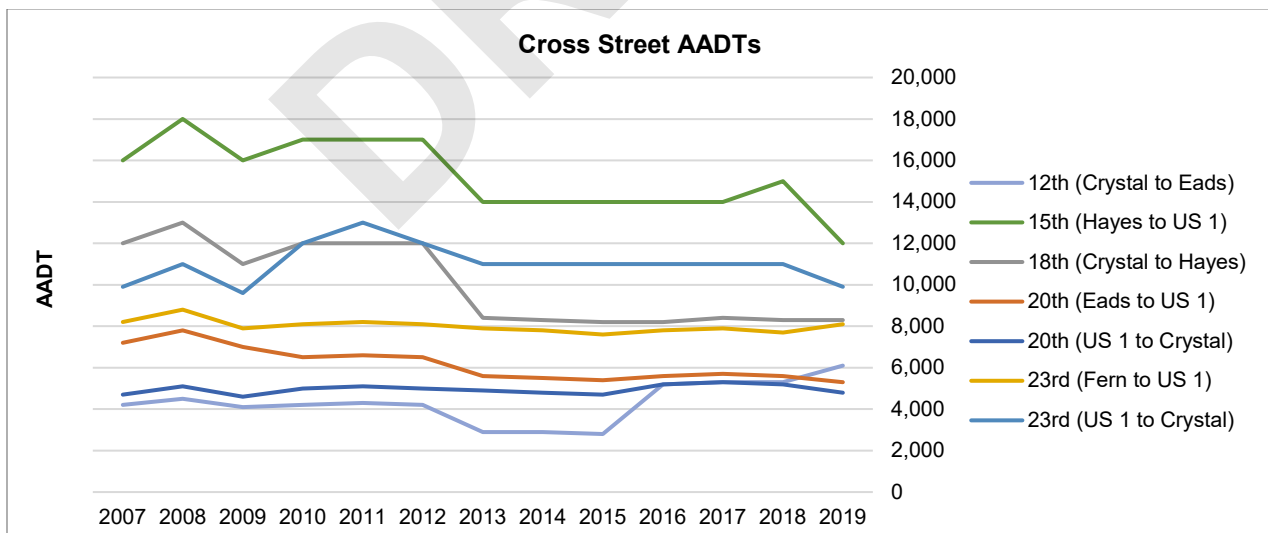
The data shown in these figures suggest that during nearly the past 15 years, traffic volumes in the study area have remained relatively flat, which one could argue indicates that the growth in other transportation modes—given the robust investments made in rail and bus transit—has served to accommodate additional travel demand in the corridor. However, traffic count data in this area is complicated by the impacts of the Great Recession and the US Department of Defense's 2005 Base Realignment and Closure (BRAC) process, which relocated 17,000 jobs from Arlington County<sup>2</sup>—many of which were in the Crystal City area and resulted in high commercial vacancy rates.

<sup>1</sup> <https://www.virginiadot.org/info/ct-TrafficCounts.asp>

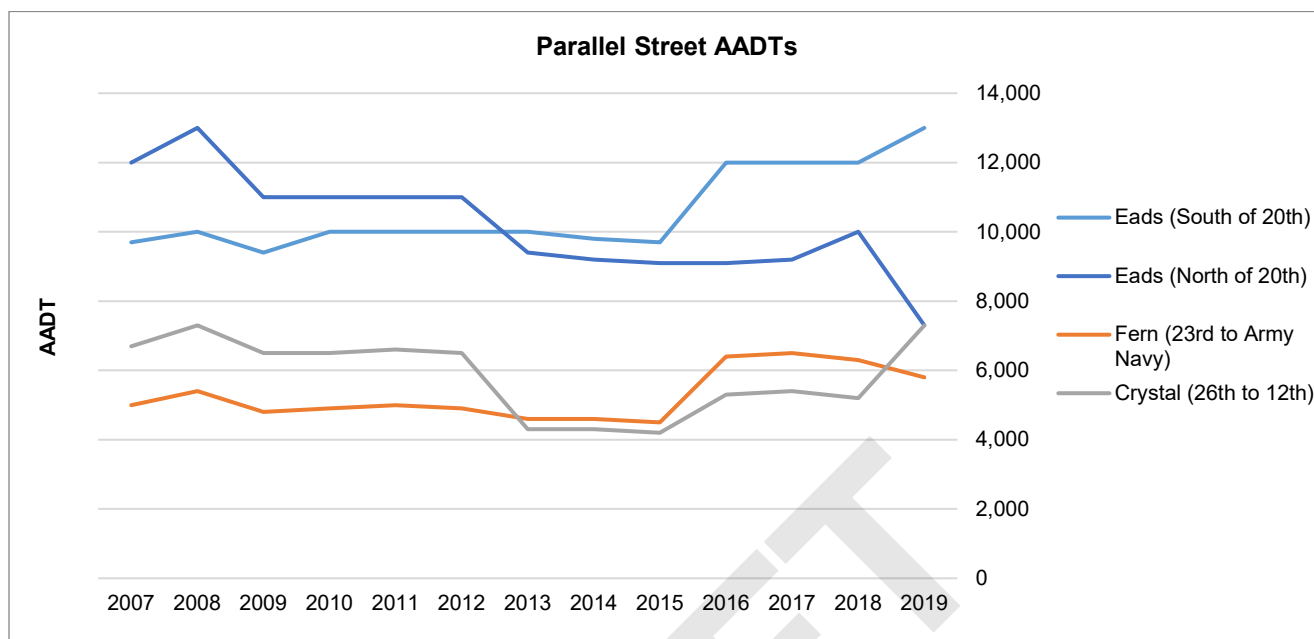
<sup>2</sup> <https://www.arlingtoneconomicdevelopment.com/resources/blog/economic-development-trends-that-shaped-a-decade-planning-and-placemaking/>



**Figure 3-10 Historic AADTs Along Route 1 in Study Area**



**Figure 3-11 Route 1 Cross Street Historic AADTs in Study Area**



*Figure 3-12 Route 1 Parallel Street Historic AADTs in Study Area*

### 3.3. Existing Multimodal Transportation Conditions

Pivoting from the discussion of the existing infrastructure and historic vehicle counts, this section of the report summarizes the existing conditions across all modes of transportation in the study area—pedestrian, bicycle, transit, and vehicle modes. Many of the analyses and operations for each mode are derived from a Vissim microsimulation model of the study area, which allows for complex modeling of interactions among all modes.

The existing multimodal data sources in the Route 1 study area were provided from the Pentagon City Planning Study effort being conducted by Arlington County. The previously collected 2019 multimodal data from the planning study was used to overcome the challenges in data collection during the COVID-19 pandemic and to have consistency between the Arlington County study and this VDOT study. Traffic volume data consisted of peak-hour turning movement and freeway mainline/ramp volumes, including heavy vehicle percentages. The only locations in which traffic counts were not available were for the ramps at the I-395/Route 1 interchange; these ramp volumes were derived using VDOT's StreetLight Data<sup>3</sup> account by obtaining estimated peak-hour volume proportions and applying these proportions to the known balanced counts along Route 1 just south of the interchange. **Appendix C, Existing Conditions**

<sup>3</sup> StreetLight Data is an online data metrics tool that enables analysis of anonymized transportation data collected from mobile devices using Location-Based Services (LBS).

**Summary Report**, discusses the data and Vissim modeling in detail, and this report is the basis for the discussion below summarizing the analysis of different existing travel modes.

### 3.3.1. Existing Pedestrian Analysis

The pedestrian study area consists of intersections along Route 1 and immediately adjacent to Route 1, also known as the Core Street Study Area, and includes sidewalks, crosswalks, and trails. The study area currently has an extensive sidewalk network in place, accommodating both sides of the roads with facilities for most of the roadways, with the exception of the inconsistent sidewalks along Route 1. Crosswalks are also available at every signalized intersection for most crossings.



*Pedestrian Crosswalk at Route 1 Offramp to 15th Street S*

**Figure 3-13** illustrates the location for pedestrian facilities that were analyzed for the study. Pedestrian counts at all study area intersections and crosswalks were provided by Arlington County and reflected in the Route 1 Vissim model. In cases where the Arlington County Pentagon City Planning Study model did not include a pedestrian crosswalk and field data was unavailable, pedestrian demand was inferred from surrounding intersections. **Figure 3-9** also shows the AM and PM peak hour pedestrian counts at critical intersections.

The most significant intersection pedestrian volumes are seen at the Route 1 and 23rd Street S/S Clark Street intersection cluster, given that this intersection provides access to various restaurants along 23rd Street S and Crystal Drive. Significant pedestrian volumes also are observed along 18th Street S under the existing Route 1 overpass—one of the pedestrian entrances to the Crystal City Metrorail station is located just to the east of this overpass.

The following factors were included for the pedestrian multimodal analysis:

- Pedestrian Crossing Distance
- Number and Type of Crosswalks
- Pedestrian Experience and Comfort
- Pedestrian Delay at Intersections

### Pedestrian Crossing Distance

**Table 3-2** summarizes the distance required to cross Route 1 and the side streets within the Core Street Study Area, including pedestrian refuges. Many existing locations along the Core Street Study Area require pedestrians to wait at a pedestrian refuge to safely cross. Pedestrian refuge areas only have capacity to hold a few pedestrians, and two-stage crossings increase pedestrian delay significantly.

**Table 3-2 Existing Pedestrian Crossing Distance and Timings**

Intersection	Crossing Route 1		Crossing Side Street	
	Crossing Distance (ft)	Median Refuge	Crossing Distance (ft)	Median Refuge
Southbound Route 1 Ramps and 15th Street S	50	-	130	Yes
Northbound Route 1 Ramps and 15th Street S	45	-	140	Yes
Route 1 and 20th Street S/S Clark Street	100	Yes	90	Yes (West Side)
Route 1 and 23rd Street S/S Clark Street	185*	Yes	115	Yes (two)

*\* The crossing distance includes crossing S Clark Street since this movement is included in the pedestrian phase timings*



**Route 1 Pedestrians Crossing Route 1 at 23rd Street S**

## AM/PM Peak Hour Pedestrian Volume

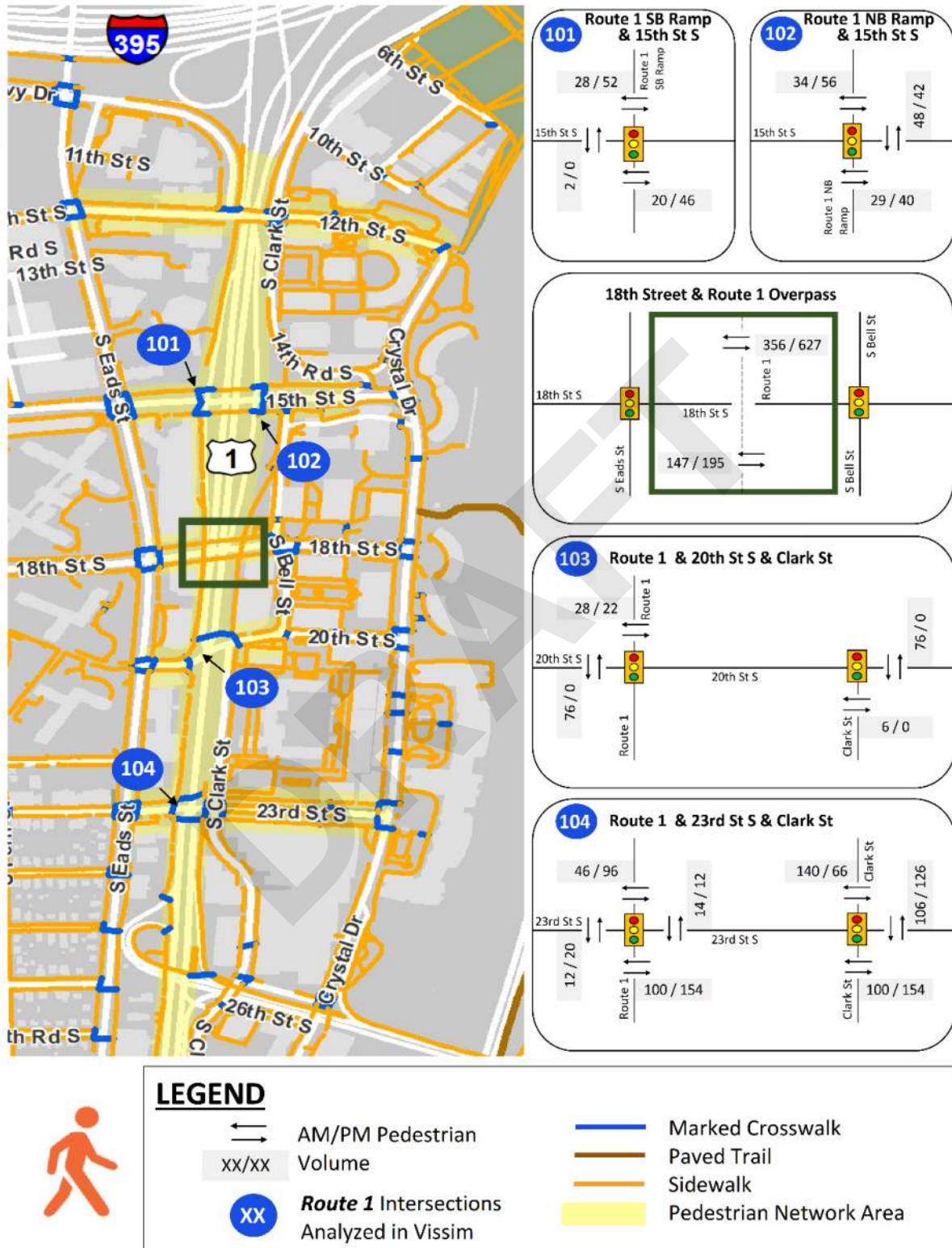


Figure 3-13 Pedestrian Network and AM and PM Peak Hour Pedestrian Volumes

### Number and Type of Crosswalks

For this study, the number of crosswalks were quantified. **Figure 3-9** illustrated the location for marked crosswalks that were within the Crystal City area. **Table 3-3** summarizes the type of crosswalk at the intersections in the Core Street Study Area.

**Table 3-3 Existing Pedestrian Crossing Types**

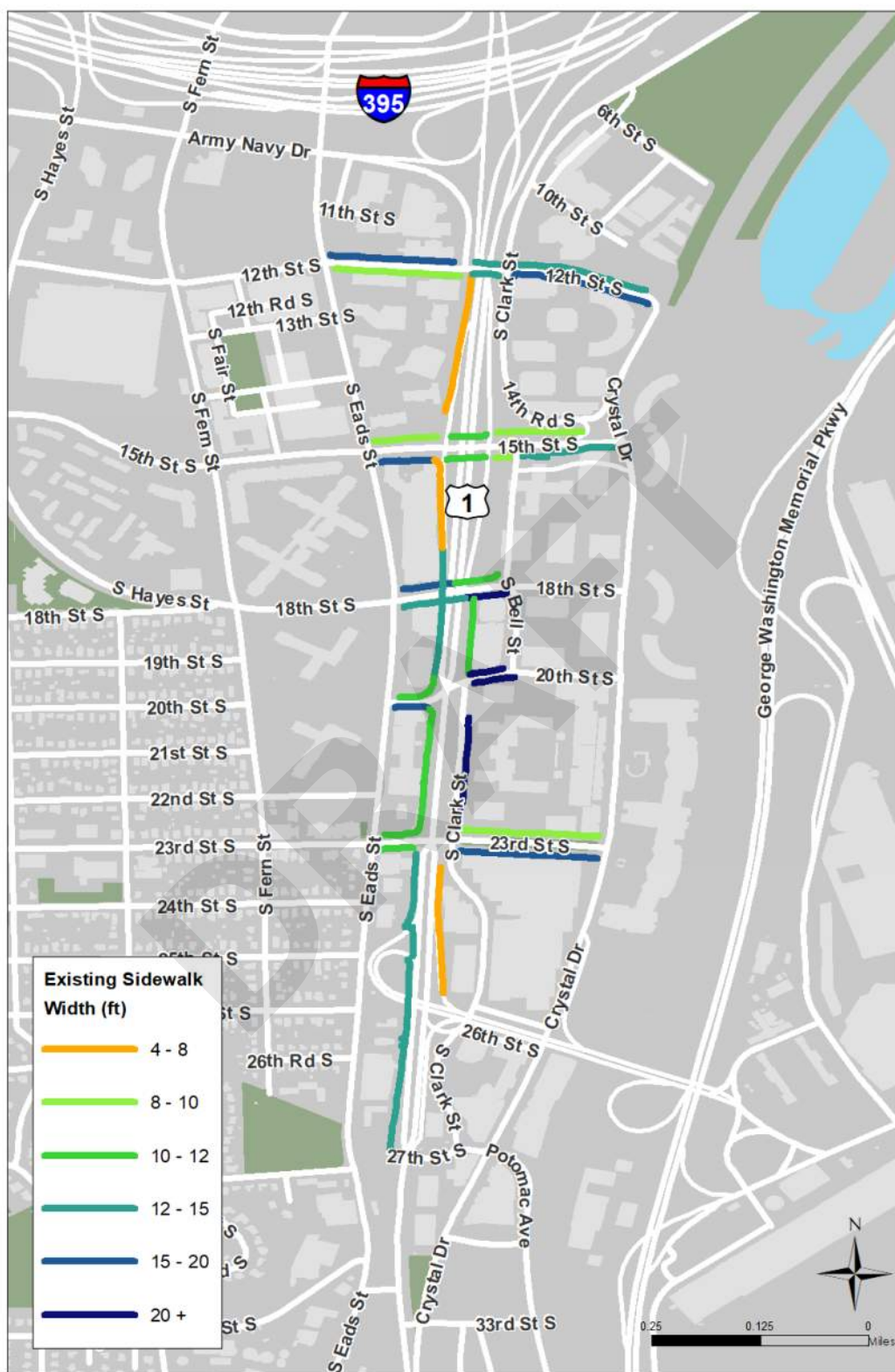
Intersection	Crossing Route 1		Crossing Side Street	
	Crosswalk	Median Refuge	Crosswalk	Median Refuge
Southbound Route 1 Ramps and 15th Street S	High Visibility	High Visibility	none	High Visibility
Northbound Route 1 Ramps and 15th Street S	High Visibility	High Visibility	High Visibility	none
Route 1 and 20th Street S/S Clark Street	High Visibility	none	High Visibility	High Visibility
Route 1 and 23rd Street S/S Clark Street	High Visibility*	High Visibility*	Standard Longitudinal with Brick Pattern	Standard Longitudinal with Brick Pattern

*\* The crosswalk crossing S Clark Street at the intersection with 23rd Street S is standard with longitudinal with brick pattern*

### Pedestrian Experience and Comfort

In Arlington County, commercial businesses own the land of many of the existing sidewalks along VDOT and county streets. Therefore, many sidewalks are not within the public right-of-way. To evaluate the pedestrian experience and comfort within the study area, an inventory of existing sidewalk widths within the study area and public space (via easements) was identified. Pedestrian experience and comfort are increased with wider available pedestrian facilities; therefore, the width of existing sidewalks is used to measure this MOE.

**Figure 3-14** illustrates the sidewalk widths along each block of the pedestrian network area. The maximum width of the sidewalk was identified for each sidewalk segment. All sidewalks have widths greater than 4 feet. There is no sidewalk adjacent to northbound Route 1 (east side of Route 1) north of 18th Street S; this location is where the S Clark Street overpass was recently removed.



### ***Pedestrian Delay at Intersections***

Delays for pedestrians at the intersections in the study vary depending on traffic signal timings. A detailed discussion about pedestrian delay at intersections is included in **Appendix C, Existing Conditions Summary Report**.

### **3.3.2. Existing Bicycle Analysis**

The bicycle study area consists of intersections along Route 1 and immediately adjacent to Route 1, also known as the Core Street Study Area. Throughout the study area, there are many on-street bike lanes and other bicycle facilities. Route 1 is in proximity to regional trails such as the Four Mile Run and Mount Vernon Trails. In general, bike lanes are most prevalent near the Crystal City Metro station, with facilities for bicyclists to ride north-south and east-west of the station. Bicycle accommodations are not provided along Route 1, which is a limited-access freeway north of 20th Street S. **Figure 3-15** illustrates the location for bicycle facilities (on-street facilities and off-street trails), as well as the locations for Capital Bikeshare stations.

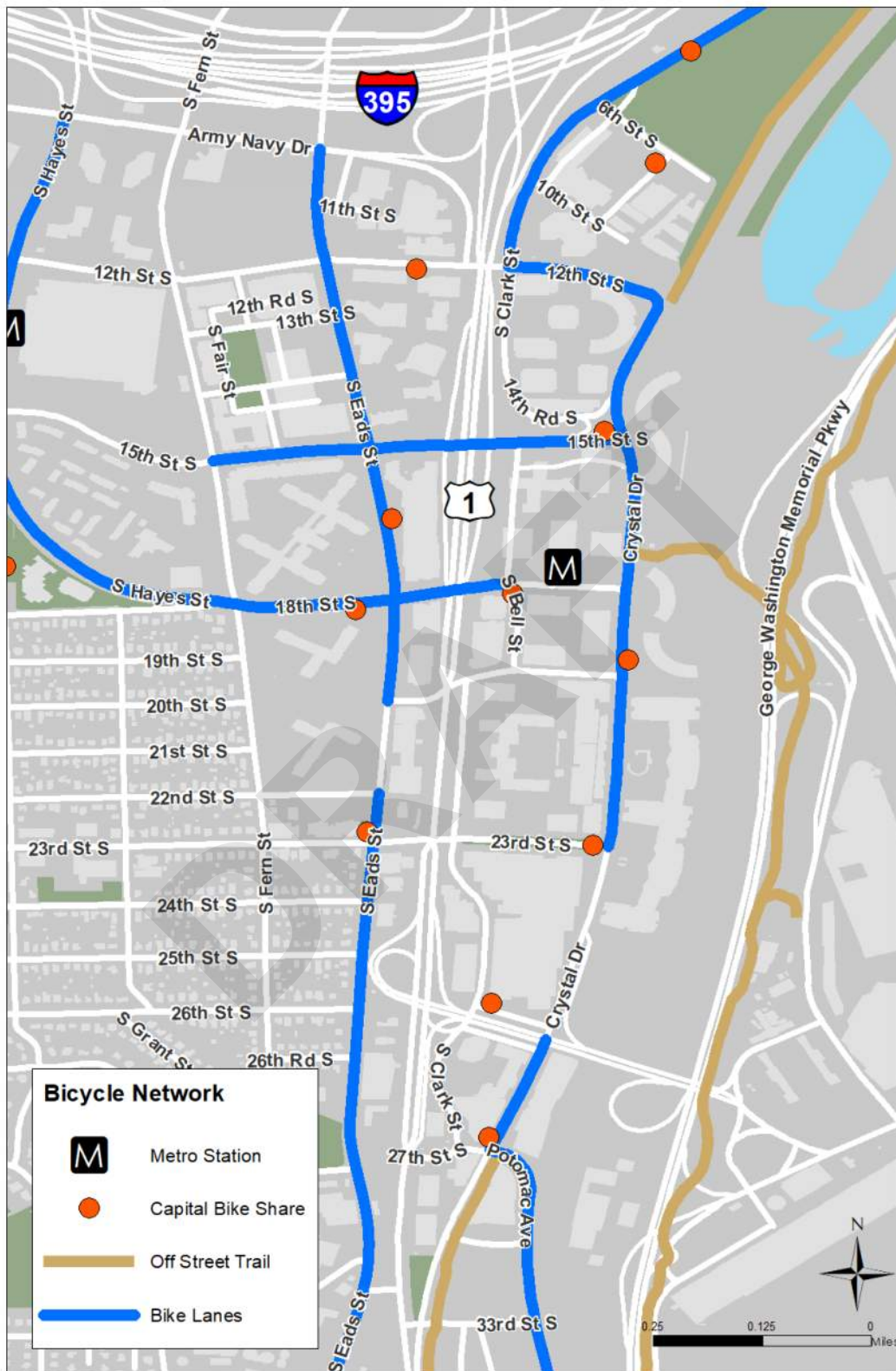
The Arlington County Pentagon City Planning Study Vissim model, which encompasses a much larger area, did not include bicycle facilities or inputs. For the Route 1 Vissim model, bicycle demand volumes were determined from the additional October 2019 data provided by Arlington County. In locations where bicycle counts were unavailable, demand was inferred from immediately adjacent locations.

The following factors were included for the bicycle multimodal analysis:

- Bicycle Level of Traffic Stress (BLTS)
- Bicycle Delay at Intersections
- Bicycle Travel Times along Key Routes



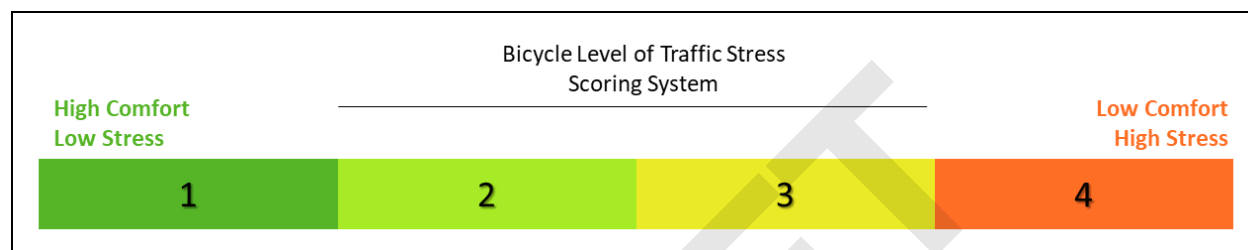
***Bicycle Lane on 18th Street S***



### Bicycle Level of Traffic Stress

To better understand the perceived comfort for bicyclists around the Route 1 study area, cross-streets were assessed with a methodology called BLTS. Given that bicycles are not allowed along Route 1, cross streets were analyzed for their segments that were within one block from Route 1. Refer to **Appendix C, Existing Conditions Summary Report**, for more information about the methodology used.

As shown in **Figure 3-16**, a street with a BLTS score of 1 provides a comfortable and low-stress riding experience for bicyclists of all ages and abilities. On the other end of the spectrum, a street with a score of 4 indicates a low-comfort and high-stress environment of which only bicyclists classified as strong and fearless could reasonably be expected to use.



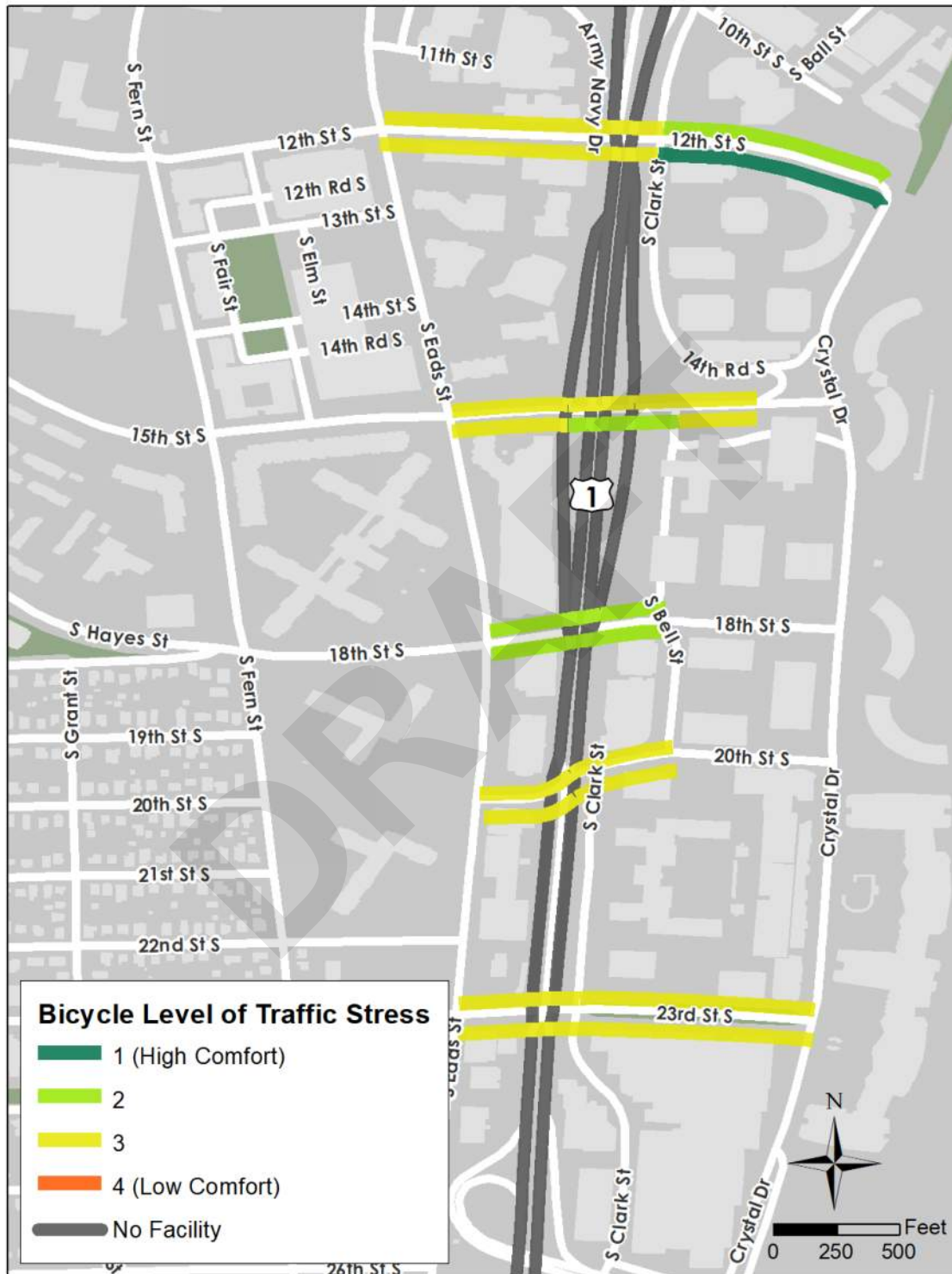
**Figure 3-16 BLTS Scoring System**

Streets with bicycle facilities are not guaranteed good scores. The scoring methodology considers contributing factors such as street width, traffic volumes, and the presence of on-street parking. Within this study area, potential for conflicts from on-street parking contributed to a higher stress environment for bicyclists. For example, streets with dedicated bike lanes can receive BLTS scores between 2 and 3 when adjacent on-street parking is present and physical protection is absent.

Within the study area, streets were segmented from intersection to intersection directionally to determine the most appropriate BLTS score. For example, the BLTS score for a side street going westbound may be different than for the segment going eastbound, as scores depend on the available facilities and roadway characteristics. BLTS scores for the overall study area were computed using the segment lengths for each BLTS score.

**Figure 3-17** below shows the location by street segment for each BLTS score. Overall, there was one segment in the study area that experiences a BLTS of 1: along eastbound 12th Street S from Long Bridge Drive to Crystal Drive. This segment has a bike lane not adjacent to parking with one through lane along a 25-mph road. The majority of the other crossing street segments were given BLTS scores of 2 or 3. Most of the segments scoring a BLTS 3 were due to the mixed traffic facilities where bicyclists share the road with traffic. These roads generally had volumes greater than 3,000 vehicles per day directionally. Those segments scoring a BLTS 2 were mostly those containing bike lanes adjacent to parking, with two through lanes, and with speeds of 25 mph. Notably, 18th Street S, which passes underneath of Route 1 and does not provide any access to or from Route 1, has a lower BLTS than the other crossings of Route 1. Dedicated bike lanes exist in each direction along 18th Street S; these bike lanes provide access to the Crystal City Metro station.

Note that the Route 1 corridor north of 20th Street S falls within the “No Facility” category in which bicyclists are not allowed access.



**Figure 3-17 Study Area BLTS**

### ***Bicycle Delay at Intersections and Bicycle Travel Times along Key Routes***

Delays for bicycles vary at each of the study area intersections, depending on traffic signal timing. Similarly, travel times also vary along key routes in Crystal City. A detailed discussion of bicycle delay and travel times is included in **Appendix C, Existing Conditions Summary Report**.

#### **3.3.3. Existing Transit Analysis**

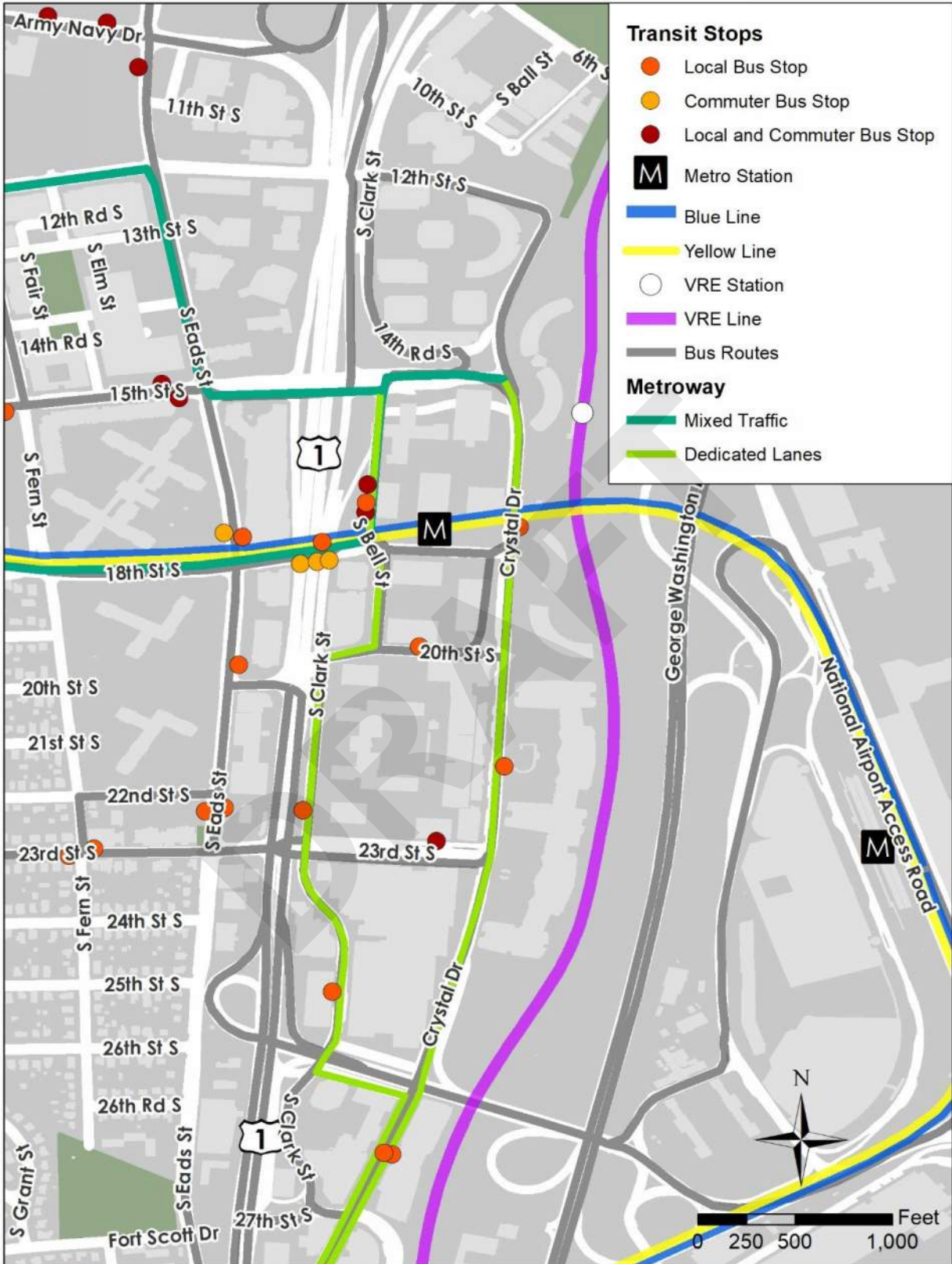
The Route 1 transit network includes Metrorail service, Metro and local bus service, and commuter bus service. This network is shown in **Figure 3-18**.

- The Metrorail Blue and Yellow lines serve the Pentagon City, Crystal City, and Washington National Airport stations via an underground tunnel through the study area, which raises to an elevated platform just north of the airport. Within the study area, the Crystal City Metrorail station is located along 18th Street S and S Bell Street immediately to the east of Route 1. There are two entrances/exits to the station, with escalators available along Bell Street and elevators available along 18th Street. This station features bike racks, bikeshare stations, and bus bays along Bell Street and 18th Street. Along 18th Street S, pedestrian and bicycle accommodations facilitate multimodal access to Metrorail. As of 2017, the Crystal City station averaged more than 10,000 daily weekday boardings.
- Regional and local bus transit is provided by two services: WMATA Metrobus and Arlington Transit (ART).
- Commuter bus transit is provided by three services: Loudoun County Transit (LCT), Potomac and Rappahannock Transportation Commission (PRTC) OmniRide, and Fairfax County (Fairfax Connector).
- Metroway is an interagency service with WMATA, Arlington County, and City of Alexandria that provides BRT service from between the Pentagon City and Braddock Road Metrorail stations. The Metroway travels on weekday peak period bus-only lanes and stops along 18th Street S and Crystal Drive within the project study area.

Overall, there are 20 bus stops in the study area that accommodate local and commuter routes. Peak headways on these routes range from less than every 10 minutes to once an hour. **Table 3-4** summarizes the different transit routes that serve the Route 1 study area, including frequency and service type.



***Metrobus Stop Along S Bell Street Near Crystal City Metro***



**Figure 3-18 Existing Transit Routes and Stops**

*Table 3-4 Existing Route 1 Study Area Bus Service*

Bus Route	Service Type	Approximate AM Peak Headway (minutes)	Approximate PM Peak Headway (minutes)
ART 43	Local	10	10
WMATA Metrobus 10A	Local	30	30
WMATA Metrobus 23B	Local	25	25
WMATA Metrobus MW1	Local	8	8
Fairfax Connector 599	Commuter	30	25
WMATA Metrobus 7A	Local	30	30
WMATA Metrobus 7F	Local	30	30
WMATA Metrobus 7Y	Local	30	-
WMATA Metrobus 23A	Local	24	15
WMATA Metrobus 22A	Local	60	60
LCT 282	Commuter	30	-
LCT 482	Commuter	30	-
LCT 682	Commuter	-	120
LCT 882	Commuter	-	30
Omni-Ride L-200	Commuter	25	25-30

Bus travel times and delays at intersections vary at each of the study area intersections, depending on traffic signal timing, as well as vehicle capacities on each of the streets in Crystal City. A detailed discussion of bus travel times and delay is included in **Appendix C, Existing Conditions Summary Report**.

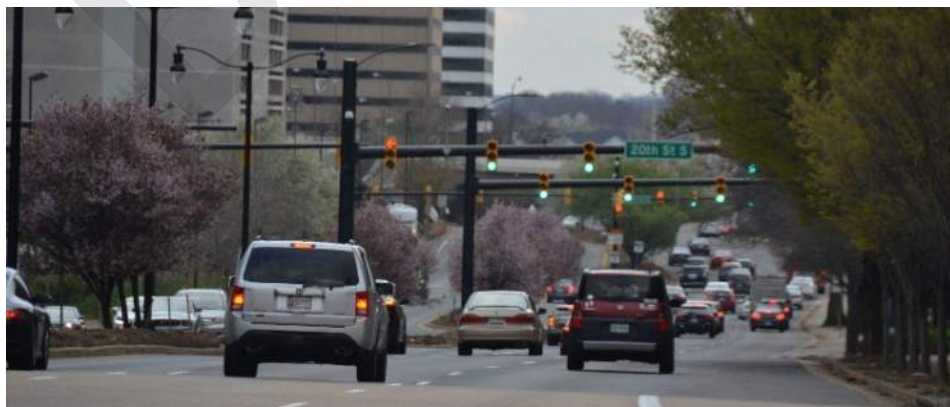
### 3.3.4. Existing Vehicle Analysis

Referring to **Figure 3-19**, there are three study area sub-designations along Route 1:

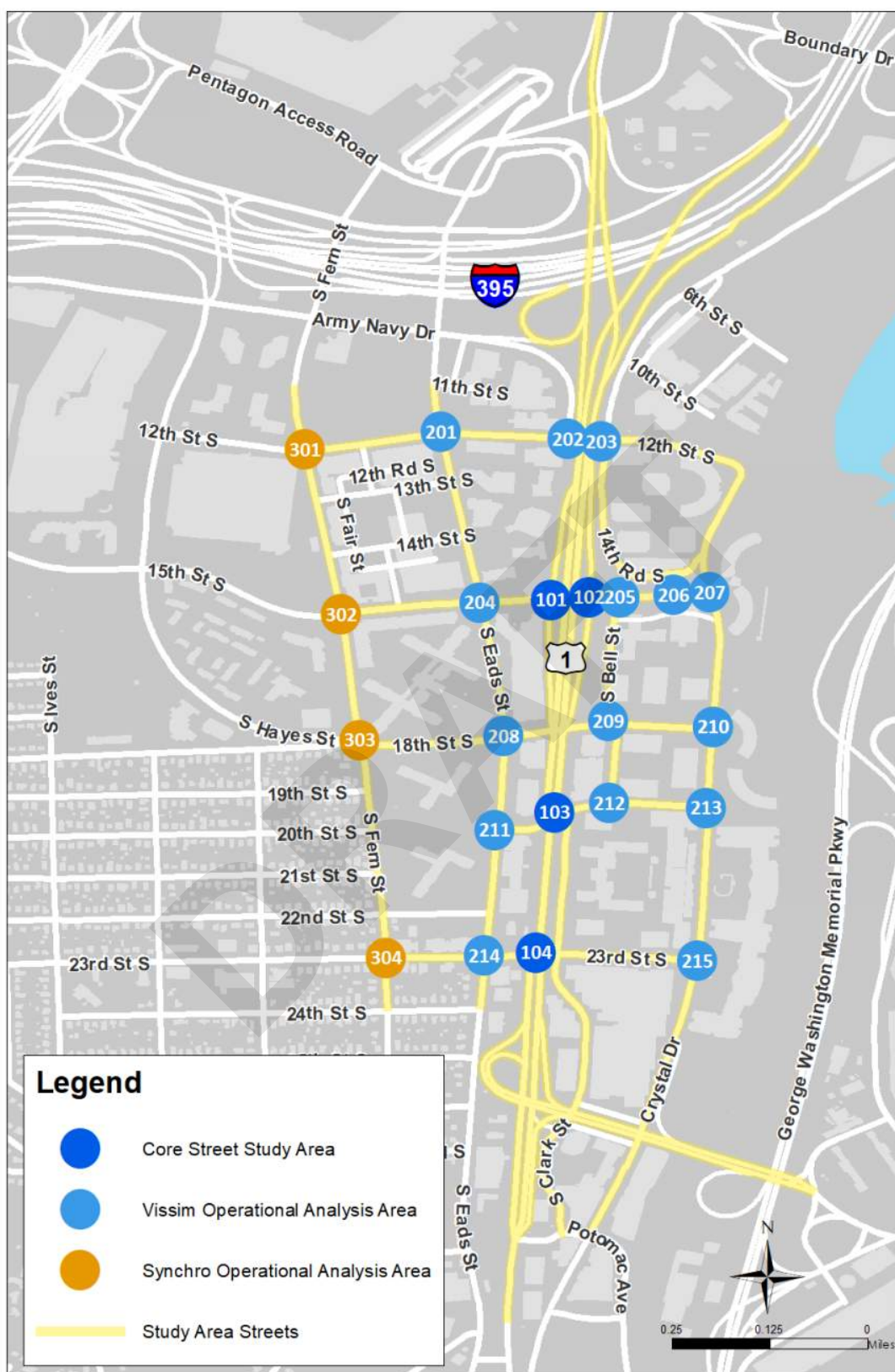
- **Core Street Study Area:** This is the concentrated area in which the street network reconfiguration alternatives and concept design was be focused. This area (shown in dark blue) had the most detailed multimodal analysis with this study.
- **Vissim Operational Analysis Area:** This area (shown in light blue) was the subject of Vissim operational (traffic) analysis.
- **Synchro Operational Analysis Area:** This area (shown in orange) was the subject of Synchro operational (traffic) analysis.

The use of the software tools for vehicle analyses is consistent with the VDOT *Traffic Operations and Safety Analysis Manual* (TOSAM) 2.0. For analysis purposes, the following interchanges were included in the project study area:

- Route 1/I-395/Route 110 – note that only the following south-facing ramps are included:
  - Southbound I-395 to southbound Route 1
  - Northbound Route 1 to northbound I-395
  - Southbound Route 110 to northbound I-395
  - Southbound Route 110 to southbound Route 1
  - Northbound Route 1 to northbound Route 110
- Route 1/15th Street S
- Route 1/Route 233 (Airport Access Road), including the ramp from westbound Route 233 to northbound Crystal Drive
- 



*Route 1 at 18th Street S (Looking South)*



The representative weekday AM and PM peak hour traffic volumes are provided in **Figure 3-20** and **Figure 3-21**, respectively.

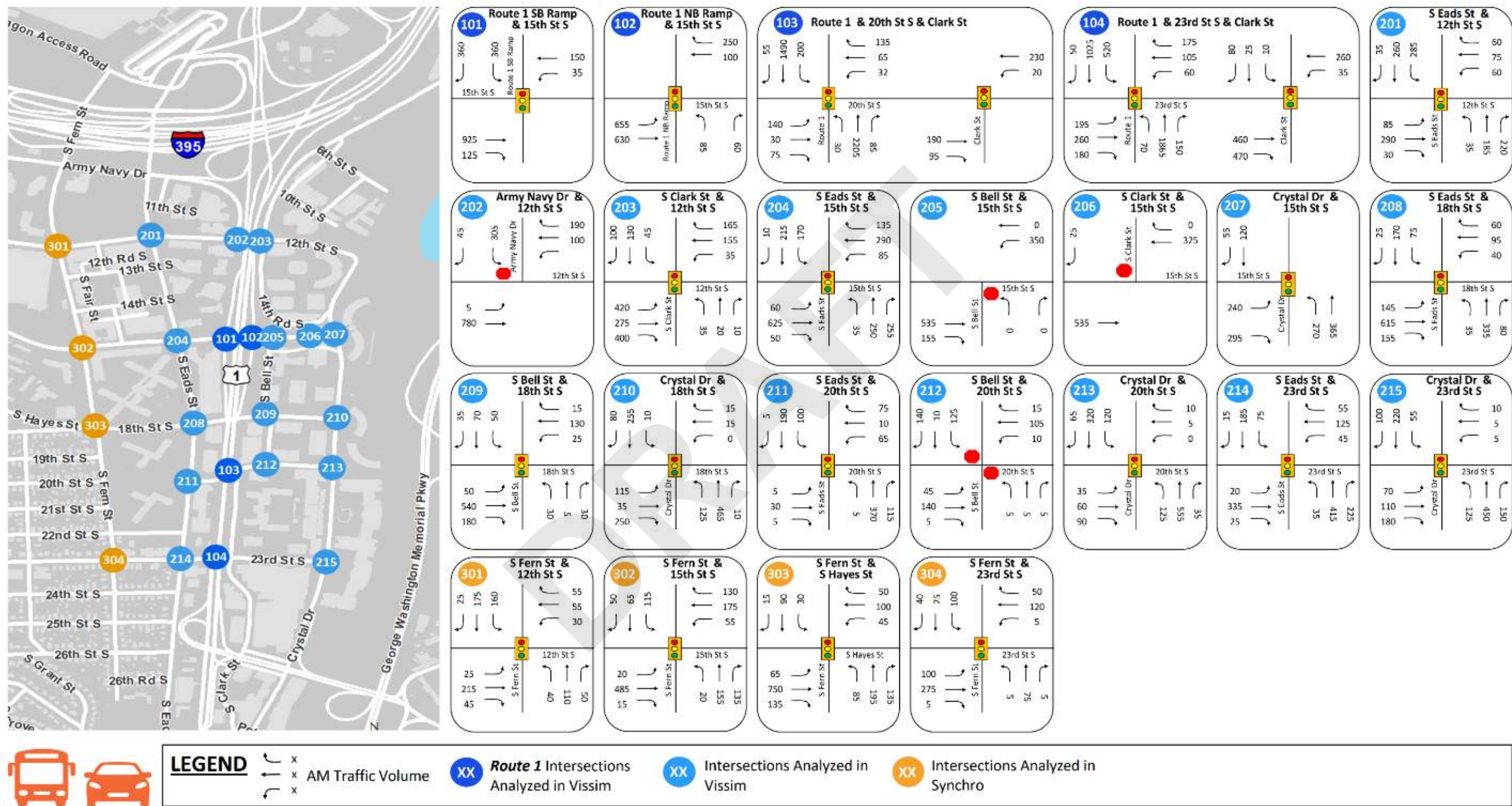


Figure 3-20 Existing AM Peak Hour Traffic Volumes



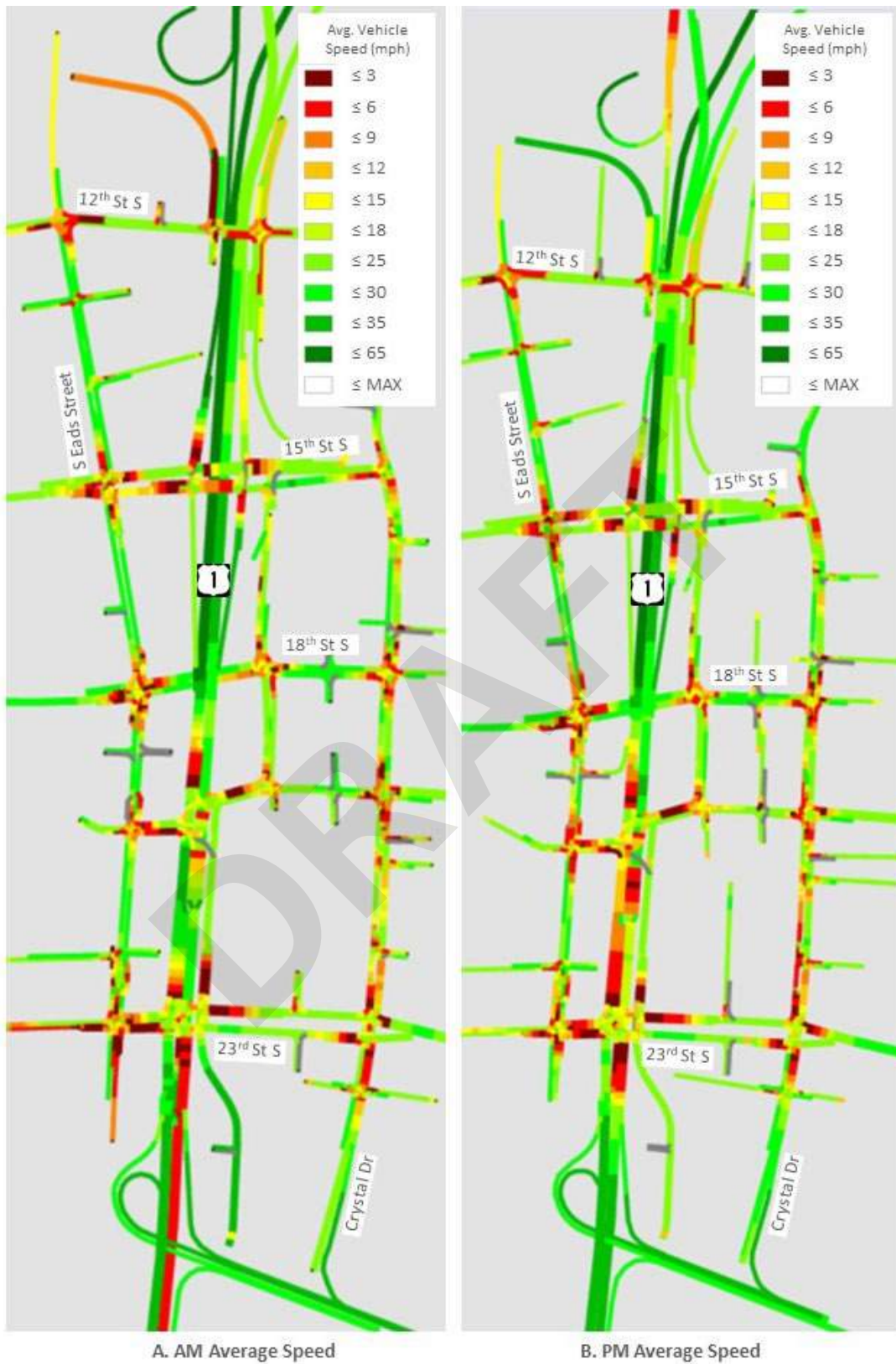
**Figure 3-22** provides an illustration of the average vehicular speeds during AM and PM peak that can be used to further understand the travel time trends. In the AM model, there are relatively higher northbound and eastbound traffic volumes as vehicles make their way eastbound through the network to turn onto Route 1 northbound. The reverse trend is observed in the PM model with more traffic traveling southbound on Route 1 and westbound on the network arterials.

The lowest speeds are concentrated along the Route 1/20th Street S/S Clark Street and Route 1/23rd Street S/S Clark Street intersection clusters. The most significant source of queueing and delay in the Core Street Study Area are tied to the complex traffic signal operations at those two intersections clusters. Both traffic signals along Route 1 provide access to adjacent S Clark Street, and in doing so must provide additional signal phases for turns onto and off S Clark Street. The additional signal phases require longer cycle lengths to accommodate all movements, most of which cannot proceed simultaneously. These situations result in delay and queue spillback especially for the highest-demand movements.

Vehicle delay, level of service (LOS), and queues all vary at each of the study area intersections, as do travel times on each of the study area streets. A detailed discussion of vehicle delay, LOS, queues, and travel times is included in **Appendix C**.



*Route 1 at 20th Street S (Looking South)*



**Figure 3-22 Vissim Operational Analysis Area AM and PM Peak Hour Average Speed Maps**

### 3.3.5. Historical Crash Analysis

An existing crash analysis was conducted by using crash data from the Virginia Roads VDOT crash database from January 1, 2015 to February 28, 2020. This time period was selected to gather the most recent 5 years of crash data prior to the COVID-19 pandemic. Crash data from the selected time period was isolated for the project study area and broken down into two separate groups:

- Route 1 Mainline Corridor Crashes
- Core Street Study Area Signalized Intersections Crashes

The Route 1 mainline crashes consisted of crashes occurring along Route 1 from I-395 to south of Route 233 that did not include incidents occurring directly along ramps (starting from the ramp gore) or crashes in the immediate vicinity of signalized intersections. The mainline crashes were those solely occurring on the Route 1 corridor, as shown in **Figure 3-23**. Separately, the crashes associated with the intersections were those within a 250-foot buffer of the intersection or within the intersection's influence area. An influence area of an intersection extends to the beginning of a storage bay or turning lane to account for all vehicular traffic volumes approaching the intersection.

The Core Street Study Area signalized intersections consisted of four intersections:

- Route 1 southbound ramps and 15th Street S intersection
- Route 1 northbound ramps and 15th Street S intersection
- Route 1 and 20th Street S/S Clark Street intersection cluster
- Route 1 and 23rd Street S/S Clark Street intersection cluster

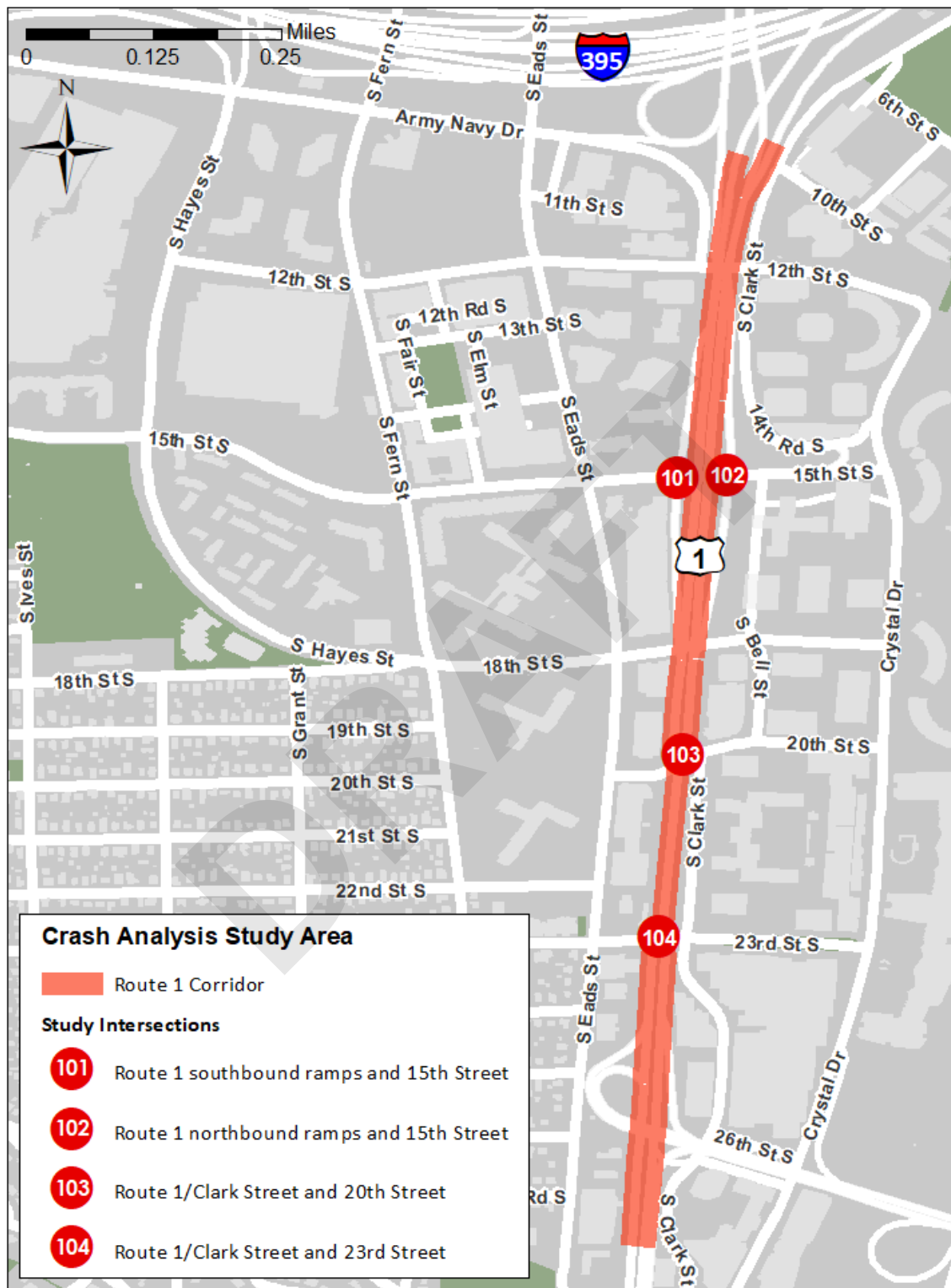
For both groups, crashes were analyzed based on crash type, severity, weather condition, light condition, time of day, and day of the week. In summary, there were 125 total crashes combined along the Route 1 mainline corridor and at the four Core Street Study Area intersections. **Table 3-5** provides the total study area crash summary by year and severity. There were no fatalities in the area and about one-third of the crashes resulted in injuries, with the rest being property damage only (PDO). Injury crashes are classified at three different levels: severe injury (Class A), visible minor injury (Class B), and possible injury (Class C). There were three severe injuries and 40 visible injuries; no possible injuries were reported. Note that the number of crashes in the study area has generally trended down during the past 5 years. There was a significant decrease in crashes from 2016 to 2017, reducing by one-half. Much of the crash reduction occurred at the interchange of the Route 1 and 15th Street S ramps. This area had 13 crashes in 2016 but only two crashes in 2017. It is unclear whether this is attributable to statistical anomaly or changes to the built environment (e.g., construction associated with the removal of the S Clark Street overpass).

**Table 3-5 Total Study Area Crash Summary**

Year	Severity				Total
	Fatality	Severe Injury	Visible Injury	PDO	
2015	0	1	9	25	35
2016	0	2	11	19	32
2017	0	0	6	10	16
2018	0	0	7	15	22
2019	0	0	5	12	17
2020 <sup>1</sup>	0	0	2	1	3
Total	0	3	40	82	125
1 Crash data for 2020 was only collected between January 1, 2020 to February 28, 2020					



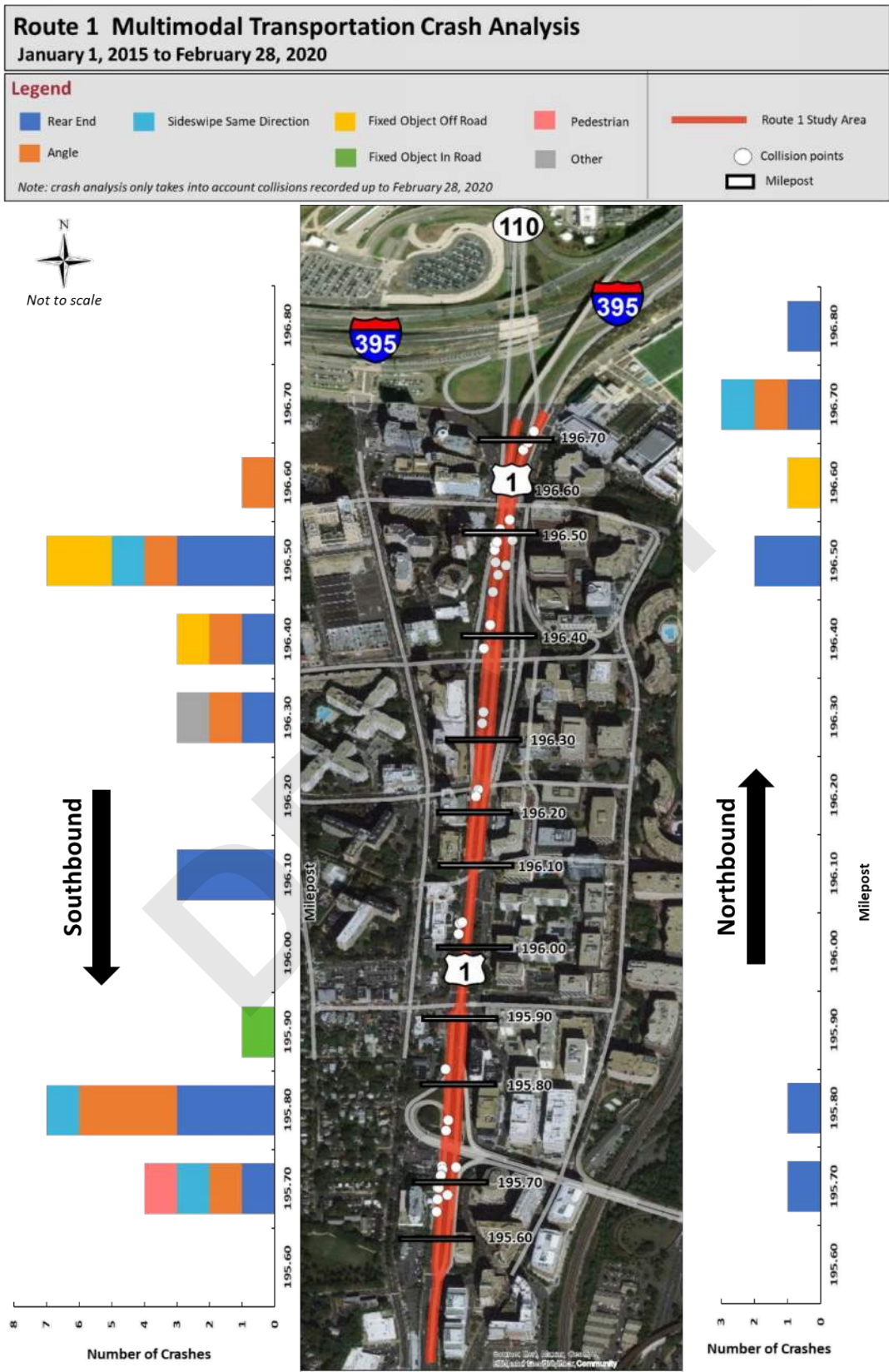
**Route 1 at 20th Street S (Looking North)**



The predominant crash type was rear end (47 percent), followed by angle (24 percent). There were more rear end and angle crashes occurring in the southbound direction than in the northbound Route 1 direction. The only pedestrian crash occurred south of the Route 233 interchange at a driveway.

Crash activity (during the identified time frame) along the corridor for the northbound and southbound Route 1 corridor is shown in **Figure 3-24**. As illustrated, the northbound direction experienced most of the crashes near the I-395 interchange ramp area, whereas the majority of crashes in the southbound direction were located near Route 233 and between I-395 and 15th Street S.

- In the northbound direction, there is a weave area between the on-ramp from 15th Street S and the split to go to either northbound Route 110 or northbound I-395, which may contribute to the increase in crashes along that area. The types of crashes occurring near the I-395 interchange are rear ends, angle, sideswipe (same direction), and fixed objects (off road)—crash types that could result from vehicles making last-minute lane changes. Additionally, during the AM peak period, this location experienced heavy mainline traffic due to queue spillback from I-395 entering Washington, DC.
- In the southbound direction, the greatest number crashes were near the Route 233 interchange. Southbound Route 1 has a choice lane leading to the off-ramp to Route 233; the southbound on-ramp (from the Route 233 loop ramp) has a very short merge lane of about 300 feet signed for drivers to yield. The crash types experienced in this area are mostly rear end, angle, and sideswipe (same direction). The highest number of angle crashes in the study area occurred at this location, likely due to traffic from the on-ramp merging with the mainline Route 1 traffic.
- Southbound Route 1 also experiences a high number of crashes along the mainline between 12th Street S and 15th Street S. This stretch has a short weave segment between where Route 110 and I-395 on-ramps merge into Route 1 and the southbound Route 1 off-ramp exits to 15th Street. The gore-to-gore weave segment is less than 350 feet, which likely contributes to high number of crashes that occurred during the 5-year period.



*Figure 3-24 Route 1 Mainline Crash Analysis Histogram*

Crashes at four signalized intersections were analyzed for this study. These intersections are within the Core Street Study Area and were identified as intersections that may be affected in future proposed alternatives. **Table 3-6** summarizes the total number of crashes by type for each intersection.

**Table 3-6 Intersection Crashes by Type**

Location	Type of Collision									Total
	Rear End	Angle	Sideswipe (opposite direction)	Sideswipe (same direction)	Fixed Object (in road)	Fixed Object (off road)	Pedestrian/ Bicycle	Head On	Other	
Southbound Route 1 ramps and 15th Street S	3	3	1	2	0	1	0	0	0	10
Northbound Route 1 ramps and 15th Street S	1	3	0	0	0	0	0	0	0	4
Route 1 and 20th Street S / S Clark Street	21	9	0	0	0	1	1	2	1	35
Route 1 and 23rd Street S / S Clark Street	9	17	0	2	0	2	7	0	1	38
<b>Total</b>	<b>34</b>	<b>32</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>8</b>	<b>2</b>	<b>2</b>	<b>87</b>

The two study area intersections with the highest number of crashes were the Route 1 and 20th Street S/S Clark Street cluster and Route 1 and 23rd Street S/S Clark Street cluster, with 35 and 38 crashes respectively. The 23rd Street cluster experienced the greatest number of pedestrian crashes, with seven crashes (18 percent) at this intersection involving pedestrians. The intersection is signalized with pedestrian push buttons and a median refuge for crosswalks across Route 1. This intersection also experiences a high number of angle crashes (45 percent), which may be due to the complicated geometry that ties together Route 1, 23rd Street S, and S Clark Street. All intersections show similar crash trends, where the most prominent collision types are rear end and angle crashes.

None of the study intersections are listed under VDOT's 2014–2018 Potential for Safety Improvements (PSI) list. This PSI list identifies the top 100 intersections in Northern Virginia based on crashes and does an initial screening to identify which locations have a historically high number of crashes when compared to other intersections with similar volumes and geometry. Though not on the PSI list, the Route 1 intersections at 20th and 23rd streets experience high numbers of rear end crashes and pedestrian crashes that could be addressed with future signal and geometric improvements. Individual crash summary sheets for each of the

four intersections analyzed can be found in **Appendix C, Existing Conditions Summary Report**.

### **3.4. Existing Conditions Summary**

It is clear from the existing conditions analysis that transportation infrastructure is evolving in Crystal City to be more multimodal to serve the growing needs of residents, business, and other land uses Crystal City is evolving in form and function. While Arlington County and private landowners have made multimodal improvements to many of the local streets, opportunities exist for VDOT to improve multimodal access along and across Route 1 to meet the needs of people traveling within and through Crystal City.

DRAFT

## 4. Future Conditions without Route 1 Improvements (No-Build)

This section summarizes the planned future of Crystal City and the associated “No-Build” Conditions analyses (i.e., the conditions with planned projects constructed without the proposed multimodal improvements to Route 1 between 12th Street S and 20th Street S). **Appendix D, Future No Build Conditions Summary Report**, discusses the analyses in detail and is the basis for the discussion below summarizing the analysis of future no build conditions.

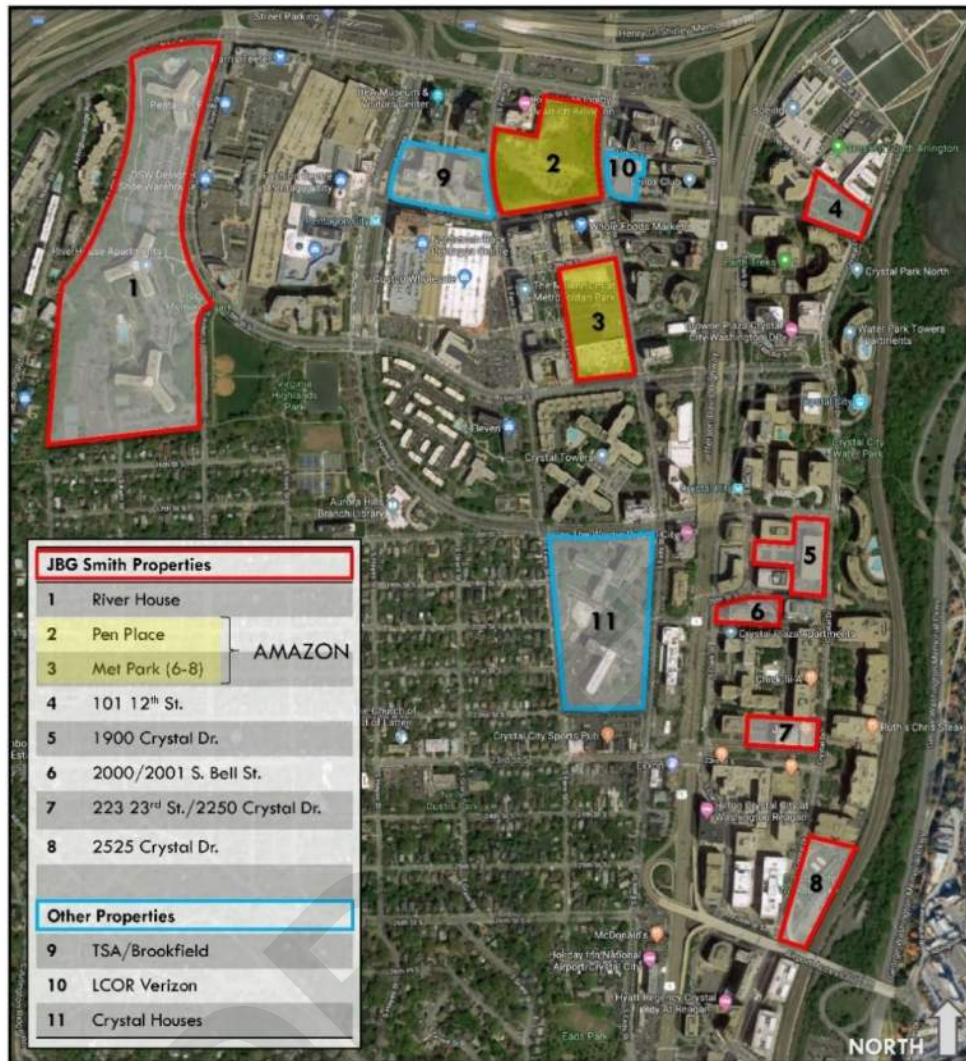
### 4.1. Land Use Forecasts and Background Developments

The Crystal City and Pentagon City areas are being planned for additional growth, and many developments have been approved, including Amazon’s HQ2. **Figure 4-1** (provided by Arlington County) shows the developments currently planned for the area.

Arlington County staff from the Department of Community Planning, Housing and Development (CPHD) provided modified land use forecasts as inputs to this VDOT study to assist in multimodal transportation modeling for future analysis years. The land use forecasts for the Route 1 Multimodal Study match the baseline land use from the county’s Pentagon City Planning Study for the 2025 and 2040 analysis years. These forecasts represent the latest development forecasts from the county, including the Route 1 study area. **Table 4-1** summarizes the forecasted total population and employment in the study area. As shown, total employment in the study area is forecasted to more than double by 2040, while total population is forecasted to increase by nearly 50 percent.

**Table 4-1 Population and Employment Projections in Route 1 Study Area**

MWCOG Zone	2021		2025		2040	
	Pop	Emp	Pop	Emp	Pop	Emp
1493	2,279	5,563	2,604	11,414	2,604	25,881
1499	539	7,505	539	9,186	648	10,579
1500	2,606	574	2,963	534	3,684	534
1501	3,611	22,408	4,232	24,118	7,755	37,537
1502	3,465	1,528	4,396	1,608	4,849	1,623
1503	553	121	576	115	588	116
1504	1,335	303	1,020	304	1,020	307
Total	14,388	38,002	16,330	47,279	21,148	76,577
	52,390		63,609		97,725	
Percent Change from Existing	-	-	13%	24%	47%	102%
	-		21%		87%	
Growth Rate (Linear)	-	-	3.4%	6.1%	2.0%	4.1%
	-		5.35%		3.58%	



	PROPOSED/ANTICIPATED GFA	PUBLIC HEARINGS SCHEDULE
<b>APPROVED APPLICATIONS</b>		
3 Met Park 6-8	2,000,000 SF of office; 100,000 SF of retail	PC/CB December 2019 (Approved)
5 1900 Crystal Drive	786,000 SF of residential	PC/CB Mar 2020 (Approved)
10 LCOR Verizon	272,000 SF of residential; 11,000 SF of retail	PC/CB October 2019 (Approved)
11 Crystal Houses	436,000 SF of residential	PC/CB December 2019 (Approved)
<b>FINAL APPLICATIONS</b>		
4 101 12 <sup>th</sup> Street	250,000 SF of office	PC/CB Fall 2020
6 2000/2001 S. Bell Street	750,000 SF of residential	TBD/Early 2021
7 223 23 <sup>rd</sup> Street/2250 Crystal Drive	490,000 SF of residential; 500,000 SF of office	TBD/Early 2021
<b>PRELIMINARY APPLICATIONS</b>		
1 River House	1,595,000 SF of residential	
8 2525 Crystal Drive	800,000 SF of residential	
<b>CONCEPT APPLICATIONS</b>		
9 TSA/Brookfield	1,487,000 SF of office/residential/hotel/retail	
<b>ANTICIPATED APPLICATIONS</b>		
2 Pen Place	2,000,000 million SF of office; retail TBD	
<b>TOTAL ANTICIPATED DENSITY</b>	<b>11,500,000 SF (APPROXIMATELY)</b>	

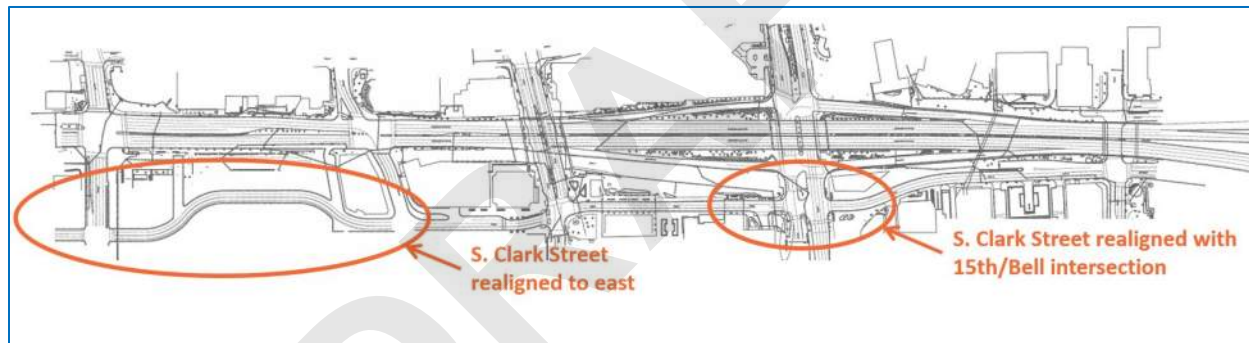
Source: Arlington County Department of Community Planning, Housing, and Development (CPHD)

**Figure 4-1 Planned and Approved Developments in Study Area**

## 4.2. Background Transportation Network Improvements

Arlington County's *Crystal City Sector Plan* includes numerous multimodal street improvements. In coordinating with VDOT during this study, Arlington County verified several planned transportation projects that will modify or improve the multimodal street network and transit operations within the Pentagon City Planning Study area for the future analysis years. **Table 4-2** lists and describes these planned projects.

Note that for 2040 No-Build conditions for this study, additional improvements were included at the intersection clusters of Route 1/20th Street S/S Clark Street and Route 1/23rd Street S/S Clark Street that are included in the Sector Plan. These improvements include relocating S Clark Street further to the east, away from Route 1 and converting S Clark Street to two-way operations. Given this realignment, the approach laneage, timings, and phasing at the Route 1/20th Street S and Route 1/23rd Street S signals can be modified and re-optimized. In addition, a new four-way intersection on 15th Street S with S Clark/S Bell Street is planned. This study assume that this intersection will be in place by 2040. **Figure 4-2** shows the 2040 no build street network for the Route 1 study area.



**Figure 4-2 Future No Build Street Network with Planned Improvements**

In addition to the improvements listed above, the Commonwealth of Virginia has committed a significant investment in its Six Year Improvement Program (SYIP) for enhanced rail and transit in the Crystal City area. This funding along with local and regional funding will further enhance the multimodal network in the Crystal City and Pentagon City areas. Further, all new development projects in Crystal City and Pentagon City are required by Arlington County to create travel demand management programs with a focus more on non-vehicle transportation (including minimal parking). The combination of multimodal investment and land use policies will further expand mode choices, i.e., people will have a multitude of travel choices other than personal vehicles. **Figure 4-3** below shows an overview of the significant transit and mobility improvements programmed in the Route 1 study area.

**Table 4-2 Background Transportation Network Improvements**

Project Name	Project Description (Within Route 1 Study Area)	Model Year		Included in Arlington County PDSP Models?
		2025	2040	
<b>Army Navy Drive Complete Street</b>	<ul style="list-style-type: none"> <li>• Repurpose travel lanes as dedicated bus lanes</li> <li>• Repurpose travel lanes to accommodate protected bike lanes</li> </ul>	✓	✓	Yes
<b>12th Street S Complete Street/Transitway Segment II</b>	<ul style="list-style-type: none"> <li>• Repurpose travel lanes as dedicated bus lanes</li> <li>• Add new traffic signal at Army Navy Drive &amp; 12th Street S</li> <li>• Additional pedestrian and bicycle accommodations</li> </ul>	✓	✓	Yes
<b>Transitway Segments I, III, and IV</b>	<ul style="list-style-type: none"> <li>• Repurpose travel lanes as dedicated bus lanes</li> <li>• Add new traffic signal at 12th Street S &amp; S Elm Street</li> <li>• Extend WMATA Metroway service along segments of Crystal Drive, 12th Street S, S Hayes Street, Army Navy Drive, S Clark Street, and S Bell Street</li> <li>• Signal phasing modifications to accommodate protected bus movements</li> </ul>	✓	✓	Yes
<b>18th Street S Complete Street</b>	<ul style="list-style-type: none"> <li>• Modify lane configuration to shorten pedestrian crossings and extend protected bike lane buffers closer to the intersections</li> <li>• Modify signal at 18th Street S &amp; S Fern Street</li> </ul>	✓	✓	Yes
<b>Met Park Traffic Signal Additions and Modifications</b>	<ul style="list-style-type: none"> <li>• Modify signal at 15th Street S &amp; S Eads Street</li> <li>• Add new signal at S Eads Street &amp; 13th Street S</li> <li>• Add new signal at S Eads Street &amp; 14th Street S</li> <li>• Add new signal at 15th Street S &amp; S Elm Street</li> </ul>	✓	✓	Yes
<b>15th Street S Realignment</b>	<ul style="list-style-type: none"> <li>• Add new signal at 15th Street S &amp; Clark Street/Bell Street</li> </ul>		✓	Yes
<b>20th Street S Realignment</b>	<ul style="list-style-type: none"> <li>• Modify lane configuration per the <i>Crystal City Sector Plan</i></li> </ul>	✓	✓	Yes
<b>20th Street S/Route 1/S Clark Street Intersection Cluster Realignment</b>	<p><b>Note:</b> improvements from Sector Plan identified by VDOT as desired to be included in Route 1 No-Build conditions</p> <ul style="list-style-type: none"> <li>• Relocate S Clark Street to east to tie into 20th Street S directly across from S Bell Street</li> <li>• Convert S Clark Street from one-way to two-way</li> <li>• Realign Route 1/20th Street S intersection to orient the EB and WB approaches directly across from each other and adjust phasing and timings accordingly</li> </ul>		✓	No
<b>23rd Street S Realignment</b>	<ul style="list-style-type: none"> <li>• Adjust EB/WB phasing at Route 1 &amp; 23rd Street S to include protected/permitted left turn movements</li> <li>• Minor adjustments to 23rd Street S &amp; S Eads Street phasing and timing</li> </ul>	✓	✓	Yes
<b>23rd Street S/Route 1/S Clark Street Intersection Cluster Realignment</b>	<p><b>Note:</b> improvements from Sector Plan identified by VDOT as desired to be included in Route 1 No-Build conditions</p> <ul style="list-style-type: none"> <li>• Relocate S Clark Street to east to tie in to 23rd Street S further to the east</li> <li>• Convert S Clark Street from one-way to two-way</li> <li>• Adjust phasing and timing at Route 1/23rd Street S intersection to eliminate dedicated phases for S Clark Street access</li> </ul>		✓	No

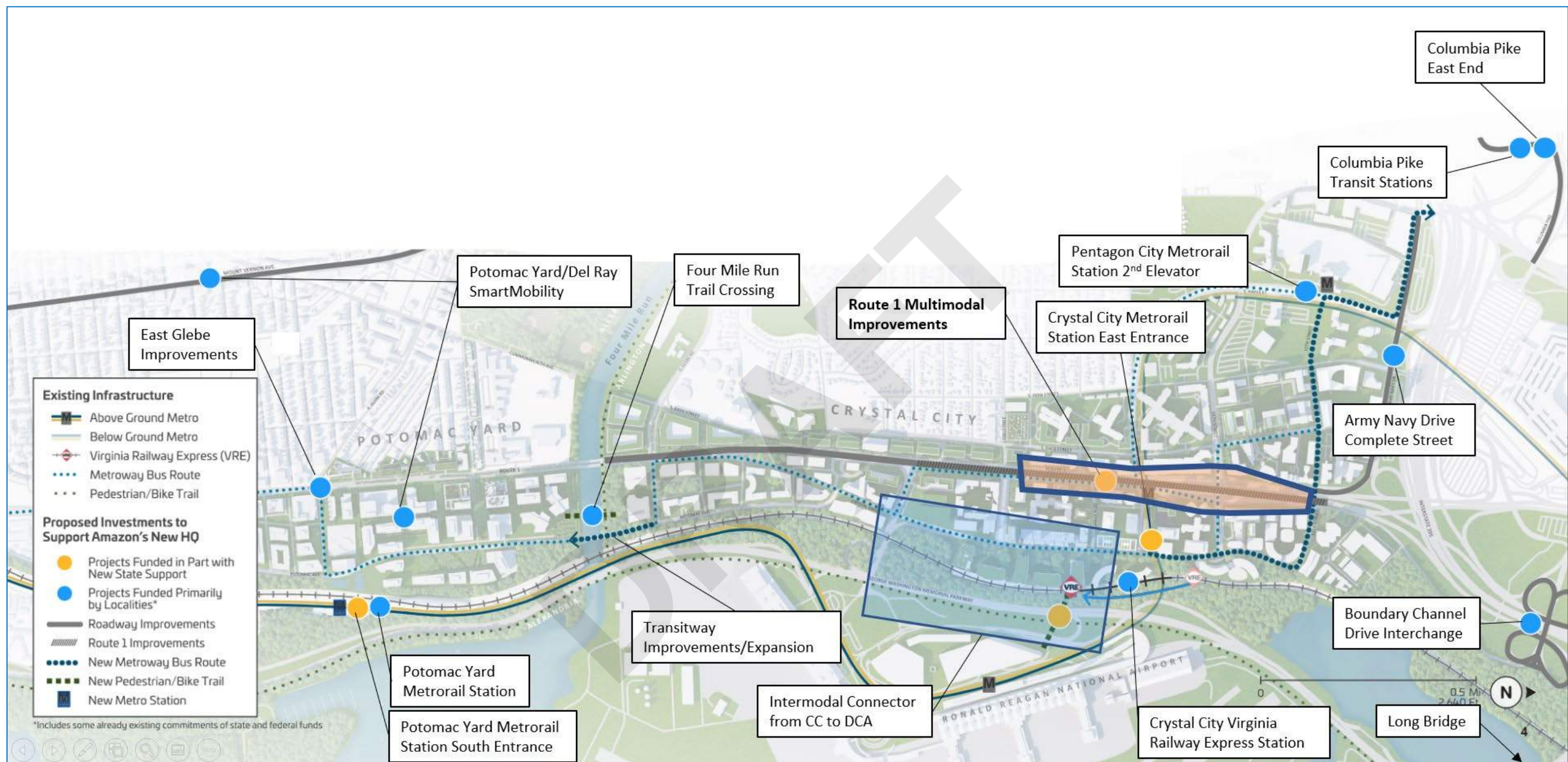


Figure 4-3 On-Going Investments in National Landing Transit and Mobility Improvements

### 4.3. Bicycle and Pedestrian Forecasts

Background forecasts for non-vehicular modes (bicycles and pedestrians) were developed using existing bicycle and pedestrian counts and adjusting these counts using the growth rates for the total population and employment in the MWCOC zones in the Pentagon City and Crystal City areas as shown in **Table 4-1**. This adjustment results in an annual growth rate for non-vehicular modes of 5.35 percent from 2019 to 2025 and 3.58 percent from 2025 to 2040. Additional pedestrian volumes were layered on top of the background forecasts at the Route 1 and 15th Street S interchange based on forecasted volumes provided in the traffic impact study for the Met Park development (development #3 shown in Figure 4-1) as well as anticipated comparable pedestrian volumes from the planned Pen Place development (development #2 in Figure 4-1). The forecasted bicycle and pedestrian volumes were provided as inputs to the 2025 and 2040 Vissim models for the Route 1 study area. The forecasted peak-hour pedestrian volumes for the east-west crossings of Route 1 are shown in **Table 4-3**.

*Table 4-3 Forecasted Peak-Hour Pedestrian Volumes for East-West Crossings of Route 1*

Crossing of Route 1	E/W Ped Crossing	Existing (2019)		2025 Forecast		2040 Forecast	
		AM	PM	AM	PM	AM	PM
15th Street S	North Side	33	56	147	168	274	302
	South Side	29	45	141	153	264	279
18th Street S	North Side	356	627	470	828	722	1,273
	South Side	147	195	194	258	298	397

### 4.4. Vehicular Traffic Forecasts

Future 2025 and 2040 No-Build vehicular traffic forecasts for the Route 1 study used Arlington County Pentagon City Planning Study volumes in accordance with the county's forecasting methodology. All relevant modifications made to the existing conditions travel demand model during the validation process were carried forward to future analysis year scenarios. The same future forecast volumes were used as the starting point for Build scenarios for the same analysis years; these volumes were redistributed within the network for the Build scenario based on the proposed geometric/operational changes.

As shown above, the Route 1, cross street, and parallel street traffic volumes have generally stayed consistent during the past 15 years. This is likely attributable to Arlington County multimodal policies and projects that have been implemented. With the continued large multimodal investments, there is opportunity to maintain the traffic volumes and potentially decrease them.

#### 4.5. Future No-Build Conditions Analysis Summary

The analysis of future no-build conditions, i.e., the future with a significant number of projects to be constructed but without the construction of any proposed Route 1 multimodal improvements, indicates the following:

- Pedestrian and bicycle conditions will largely remain similar to existing conditions, especially along Route 1, with the exception of the planned Arlington County projects.
- At the Route 1/15th Street S interchange, traffic demand is forecasted to increase for several conflicting movements, especially in the AM peak hour. These movements include the northbound through and eastbound left-turn movements (representing trips out of the study area north toward Washington, DC, or the Rosslyn-Ballston corridor) as well as the southbound left-turn movements (representing trips into the study area). The current configuration of the interchange generally allows for these movements to be accommodated with acceptable delay and LOS into the future No-Build conditions.
- Along 18th Street S, the intersections with S Eads Street and S Bell Street operate with acceptable delay and LOS into the future No-Build conditions. The 18th Street S underpass below Route 1 is forecasted to see continued high pedestrian volumes given its proximity to the Crystal City Metro Station, with several hundred pedestrians per hour forecasted by the 2040 PM peak hour.
- North-south travel times along Route 1 through the study area (between SR 233 and I-395) do not significantly increase from existing conditions by 2040. This finding can be attributed in part due to the Sector Plan improvements planned to be implemented for the Route 1 intersections with 20th Street S and 23rd Street S.

Looking to the future, opportunities exist for Route 1 to be reconstructed to compliment the planned land uses and planned transportation improvements—for Route 1 to become an urban boulevard while meeting the future multimodal travel demand needs within the corridor.

## 5. Stakeholder Involvement

Stakeholder engagement is a critical component of any effective transportation planning process, and VDOT offered multiple opportunities for stakeholder agencies and the public to provide input during this Phase 1 of the Route 1 Multimodal Improvements study. The goal was to have an inclusive and representative process for all aspects of the study. Engaging stakeholders early and often—through a Route 1 Task Force and using surveys, public meetings, comment forms, and other means of communication—allowed VDOT to receive meaningful feedback regarding the stakeholder priorities and concerns throughout the Phase 1 study period of fall 2020 through fall 2021.

### 5.1. Route 1 Task Force

Stakeholder engagement first involved the formation of a Route 1 Task Force, which was intended to build upon the successes of the Crystal City Task Force that guided the development of the *Crystal City Sector Plan*. To this end, VDOT invited representatives from agencies, businesses, and neighborhood groups to participate in meaningful discussions and help guide the development of this study. Route 1 Task Force members provided feedback on public involvement strategies, the study process, and technical findings. The Route 1 Task Force included members from the following organizations:

- Crystal City Citizens Review Council
- National Landing BID
- Arlington Ridge Civic Association
- Aurora Highlands Civic Association
- Crystal City Civic Association
- Arlington County Planning Commission
- Arlington County Transportation Commission
- Arlington County Bicycle Advisory Committee
- Arlington County Pedestrian Advisory Committee
- Arlington County Transit Advisory Committee
- Arlington County Transportation Division
- City of Alexandria
- VRE
- WMATA
- MWAA
- NPS
- VDOT

VDOT asked the members of the Route 1 Task Force to represent their organizations and participate in the Route 1 Multimodal Improvements Study, to provide feedback to VDOT and Arlington County on study findings and recommendations, and to advocate for input to the study from stakeholders and the general public. The members did so, and the meetings were beneficial in developing the Metroquest survey and in preparing for the public information meetings. Virtual Task Force meetings took place through the Microsoft Teams platform on

September 29 and December 7, 2020 and on March 3 and June 16, 2021. Summaries of these meetings are included in **Appendix E** of this report.

## 5.2. Public Outreach

Public outreach was held in three rounds to solicit input and feedback from the public and stakeholders. Each round had a specific objective for seeking input that was used to inform the technical study processes.

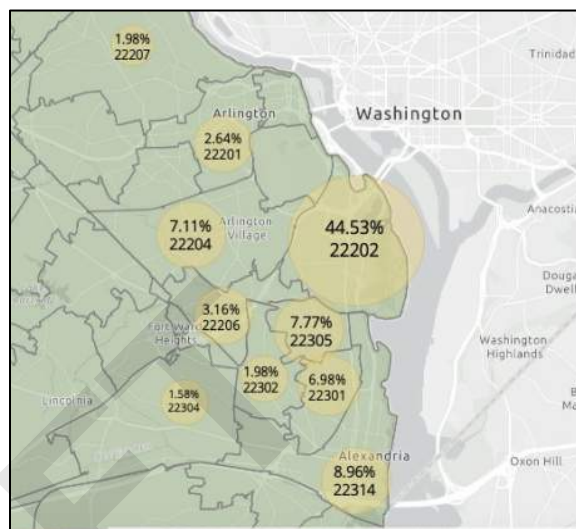
- Round 1
  - *MetroQuest Survey (mid-October to mid-November 2020)*: The objective of this outreach effort was to engage the public and encourage participation in an online survey that gauged initial community preferences and priorities. The study team used the input to assist in evaluating potential improvements for the study corridor.
  - *Virtual Public Information Meeting (PIM) #1 (December 16, 2020)*: The purpose of the virtual PIM #1 was to engage the public and stakeholders to review results of the online survey and existing mobility and safety conditions in the corridor. The public provided feedback on the analyses and results presented by the study team.
- Round 2
  - *Virtual PIM #2 (March 2021)*: The purpose of the virtual PIM #2 was to seek input and feedback from the public and stakeholders on proposed design elements along the study corridor. The public provided feedback on design elements presented.
- Round 3
  - *Virtual PIM #3 (June 2021)*: The purpose of virtual PIM #3 was to engaged public and stakeholders in providing feedback on study analysis result and the study concepts through a virtual outreach event. The public provided feedback on the various concept designs and on VDOT's recommended concept.

This study relied on the input of the Route 1 Task Force and the many participants in the PIMs. The study team executed a promotional campaign for each round of engagement to generate awareness and participation.

The following sections provide an overview of the Metroquest survey and public meeting outreach strategies and results by the numbers and discusses how the study team used public input to inform decisions.

### 5.3. MetroQuest Public Engagement Survey

A Route 1 Multimodal Improvements Study online survey was open to the public from October 15 to November 15, 2020. The survey platform was established using MetroQuest, a company that specializes in online public engagement for urban and transportation projects. The purpose of this MetroQuest survey was to gauge community preferences and priorities to assist VDOT in evaluating potential multimodal improvement concepts of this Route 1 Multimodal Improvements Feasibility Study. The MetroQuest survey for Route 1 was comprised of five survey screens. Responding to each screen and the corresponding questions was optional, and participants were not required to interact with every question on every screen. A full summary of the survey questions and responses can be found in **Appendix F** of this report. A total of 1,224 unique survey submissions were received. Forty-five percent of participants who identified their home zip code said they lived in 22202.



#### Email campaign

**3** emails were sent throughout the month the survey was open. By the end of the campaign, the distribution list had **76** people. On average, there was a **53.5%** open rate and a **25.7%** click rate.



#### Paid social media campaign

A paid social media campaign on Facebook and Instagram targeted zip codes within the study area. **3** ads achieved a total of **394,119** impressions.

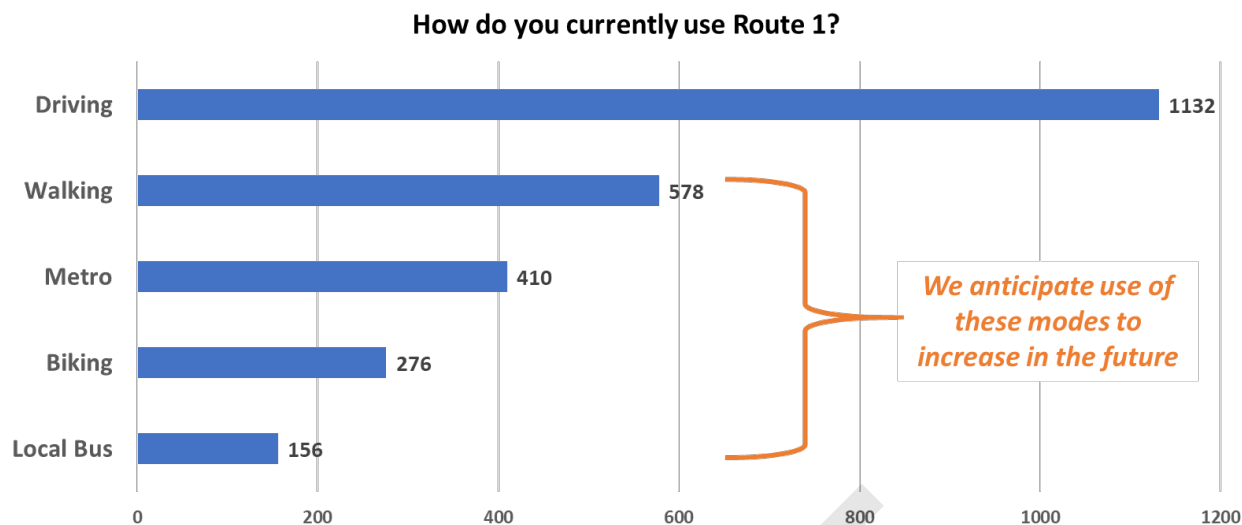


#### Press Release

A press release was distributed to **133** contacts

### MetroQuest Survey “By the Numbers”

Some of the key takeaways from the survey were the current uses along Route 1, which are shown in **Figure 5-1**. There were 1,218 responses provided to the multiple-choice question on current use of the Route 1 corridor. Many people currently drive the study corridor and a good portion of users walk or bike the area. (As discussed in Chapter 4 of this report, the number of pedestrians and cyclists is anticipated to increase in the future with Arlington County’s investments in multimodal infrastructure.)



**Figure 5-1 Travel Survey – Existing Use**

The public provided input on the design priorities as shown in **Figure 5-2**. Pedestrian safety received the highest average rank among the different priorities. A total of 2,568 individual comments were received as part of the online survey. Survey results were used to assist the VDOT study team in evaluating potential multimodal improvements in the Route 1 corridor between 12th Street S and 23rd Street S.



**Figure 5-2 Travel Survey – Design Priorities**

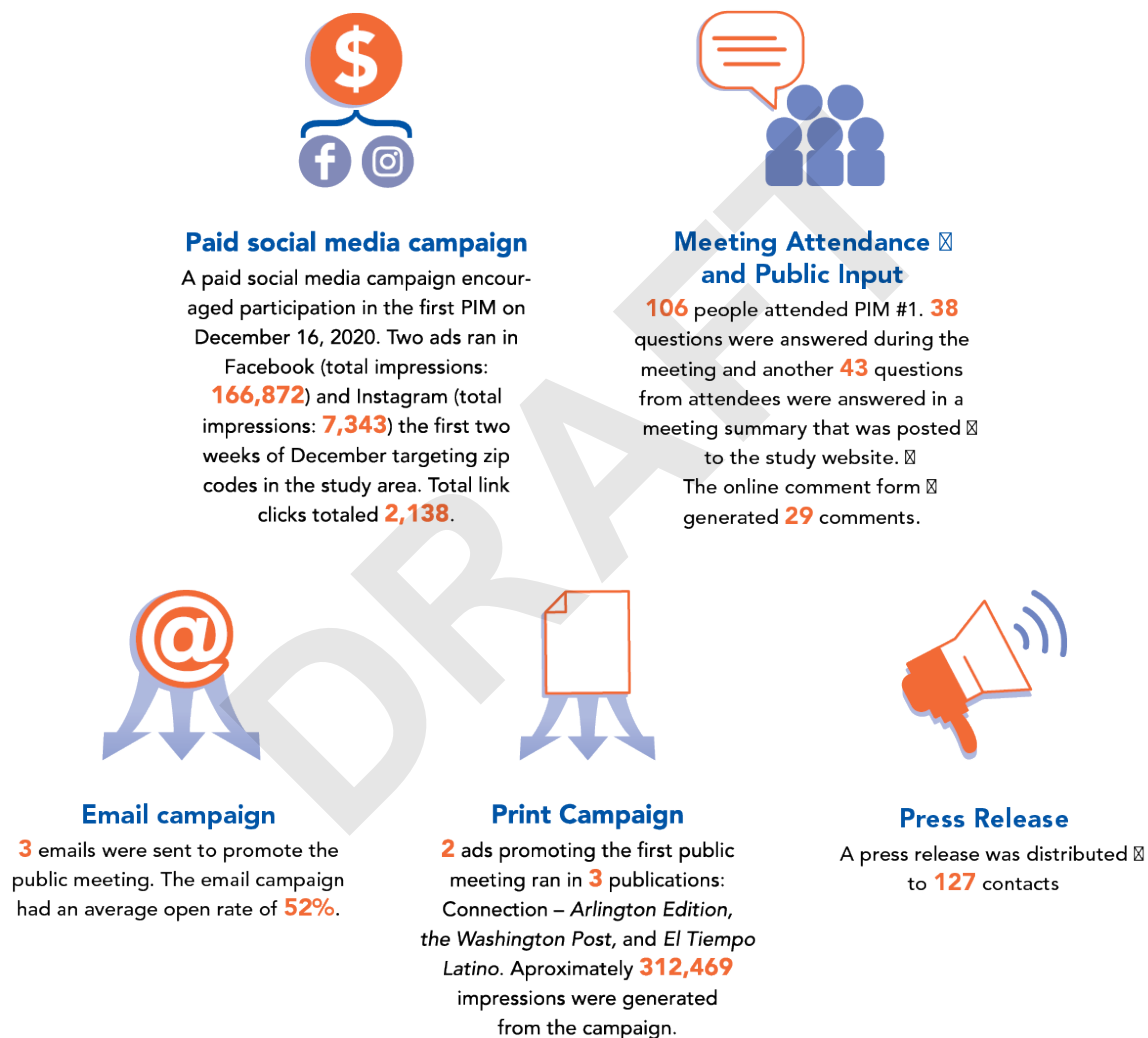
## 5.4. Public Information Meeting #1 Overview and Promotion

VDOT held the first of three PIMs on December 16, 2020 to give the public the opportunity to review existing conditions and hear about MetroQuest survey results as well as ask questions and provide input on the Route 1 Multimodal Improvements Study. A public comment period ran from December 16, 2020 through January 11, 2021. In addition to a question-and-answer session during the public meeting, this comment period allowed the public another option for submitting feedback using an online comment form on the study website. The public also was

able to submit comments through the project email address and by regular mail at any point throughout the study. For a reference of the comments received and responses provided by VDOT, see the PIM #1 summary, **Appendix G-1**.

The study team used feedback from PIM #1 on the existing conditions analysis results, existing conditions challenges, and design priorities to develop and analyze design concepts for potential Route 1 multimodal improvements.

### *PIM #1 “By the Numbers”*



### PIM #1 “By the numbers”

**Paid Social Media:** A paid social media campaign encouraged participation in the first PIM on December 16, 2020. Two ads ran in Facebook (total impressions: **166,872**) and Instagram (total impressions: **7,343**) the first two weeks of December targeting zip codes in the study area. Total link clicks totaled **2,138**.

**Organic Social Media:** [X number of] Facebook posts, [X number] Twitter posts, and [X number] of Instagram posts also promoted PIM #1.

**Meeting Attendance and Public Input:** **106** people attended PIM #1. **38** questions were answered during the meeting and another **43** questions from attendees were answered in the a meeting summary that was posted to the study website. The online comment form generated **29** comments.

**Email Campaign:** Three emails were sent to promote the public meeting. The email campaign had an average open rate of **52%**.

**Print Campaign:** Two ads promoting the first public meeting ran in three publications: *Connection – Arlington Edition*, the *Washington Post*, and *El Tiempo Latino*. [X number of] impressions were generated from the campaign.]

**Press Release:** A press release was distributed to [where.]

Note: “Total impressions” means the number of times someone online views information about the PIM.

## 5.5. Public Information Meeting #2 Overview and Promotion

VDOT held the second of three virtual PIMs on March 3, 2021. The purpose of PIM #2 was to give the public the opportunity to provide input on the no build conditions analysis and on proposed initial design elements for the corridor and to ask questions and address concerns with the study team. A public comment period ran from March 3 through March 15, 2021. In addition to a question-and-answer session during the public meeting, this comment period allowed the public another option for submitting feedback using an online comment form on the study website. Additionally, the public was able to submit comments through the project email address and by regular mail at any point throughout the study. For a reference of the comments received and responses provided by VDOT, see the PIM #2 summary, **Appendix G-2**.

## PIM #2 “By the Numbers”



### Paid social media campaign

A paid social media campaign encouraged the public to attend the second PIM on March 3, 2021. Two ads ran in Facebook (total impressions: **274,559**) and Instagram (total impressions: **4,087**) the last week of February and the first week of March, targeting zip codes in the study area. Total link clicks totaled **2,723**.



### Meeting Attendance and Public Input

**96** people attended the public information meeting on March 3, 2021. **60** questions asked by the public were answered during the meeting. The online comment form generated **16** comments.



### Email campaign

**3** emails were sent to promote the PIM #2. The campaign had an average open rate of **54%**.



### Print Campaign

**2** ads promoting the first public meeting ran in **3** publications: Connection – Arlington Edition, the Washington Post, and El Tiempo Latino. Approximately **312,500** impressions were generated from the campaign.



### Press Release

A press release was distributed to **129** contacts

### PIM #2 “By the numbers”

**Paid Social Media:** A paid social media campaign encouraged the public to attend the second PIM on March 3, 2021. Two ads ran in Facebook (total impressions: **274,559**) and Instagram (total impressions: **4,087**) the last week of February and the first week of March, targeting zip codes in the study area. Total link clicks totaled **2,723**.

**Organic Social Media:** [X number of] Facebook posts, [X number] of Twitter posts, and [X number] of Instagram posts also promoted PIM #2.

**Meeting Attendance and Public Input:** **96** people attended the public information meeting on March 3, 2021. **60** questions asked by the public were answered during the meeting. The online comment form generated **16** comments.

**Email Campaign:** Three emails were sent to promote the PIM #2. The campaign had an average open rate of **54%**.

**Print Campaign:** Two ads promoting the first public meeting ran in three publications: *Connection – Arlington Edition*, the *Washington Post*, and *El Tiempo Latino*. [X number of] impressions were generated from the campaign.

**Press Release:** A press release was distributed to [where.]

## 5.6. Public Information Meeting #3 Overview and Promotion

VDOT held the third and final virtual PIM on June 16, 2021. During this PIM, the study team shared updated At-Grade concepts and Future Build conditions with the public. A public comment period ran from June 16 through July 12, 2021. In addition to a question-and-answer session during the public meeting, this comment period allowed the public another option for submitting feedback using an online form on the study website. Additionally, the public was able to submit comments through the project email address and by regular mail at any point throughout the study. For a reference of the comments received and responses provided by VDOT, see the PIM #3 summary, **Appendix G-3**.

### PIM #3 “By the Numbers”



#### Paid social media campaign

A paid social media campaign encouraged the public to attend the final PIM on June 16, 2021. One ad ran in Facebook (total impressions: **66,911**) and Instagram (total impressions: **17,014**) during the second week of June, targeting zip codes in the study area. Total link clicks totaled **791**.



#### Meeting Attendance and Public Input

**100** people attended the public information meeting on June 16, 2021. **55** questions asked by the public were answered during the meeting. The online comment form generated **52** comments.



#### Email campaign

**3** emails were sent to promote PIM #3. The campaign had an average open rate of **45%**.



#### Print Campaign

**2** ads promoting the first public meeting ran in **3** publications: Connection – Arlington Edition, the Washington Post, and El Tiempo Latino. Approximately **312,469** impressions were generated from the campaign.



#### Press Release

A press release was distributed to **133** contacts

### PIM #3 “By the numbers” graphic placeholder:

**Paid Social Media:** A paid social media campaign encouraged the public to attend the final PIM on June 16, 2021. One ad ran in Facebook (total impressions: **66,911**) and Instagram (total impressions: **17,014**) during the second week of June, targeting zip codes in the study area. Total link clicks totaled **791**.

**Organic Social Media:** [X number of] Facebook posts, [X number] of Twitter posts, and [X number] of Instagram posts also promoted the upcoming public meeting.

**Meeting Attendance and Public Input:** **100** people attended the public information meeting on June 16, 2021. [X] questions asked by the public were answered during the meeting. The online comment form generated **52** comments.

**Email Campaign:** Three emails were sent to promote PIM #3. The campaign had an average open rate of **45%**.

**Print Campaign:** Two ads promoting the first public meeting ran in three publications: *Connection – Arlington Edition*, the *Washington Post*, and *El Tiempo Latino*. [X number of] impressions were generated from the campaign.

**Press Release:** A press release was distributed to [where.]

## 5.7. Additional Stakeholder Interface

In addition to the Route 1 Task Force meetings, the public survey, and the three PIMs, this study relied on input from Arlington County staff through regular coordination meetings, as well as input from two groups:

- The National Landing BID provided input in the form of its ***Reimagine Route 1*** document and through input during Task Force meetings and PIMs; previous BID documents also contributed input to this study, including the ***Area-Wide Strategic Plan***
- The civic associations of Arlington Ridge, Aurora Highlands, and Crystal City in the 22202-zip code came together to develop its ***Livability 22202 Action Plan***, which helped to guide this study. Members of these civic associations also provided input during Task Force meetings and the PIMs.

The Route 1 study team considered existing conditions, planned future conditions, and stakeholder input to develop a range of possible concepts for a Route 1 urban boulevard. As discussed in this chapter, concept development built upon the knowledge base discussed in Chapters 3 and 4, as well as the stakeholder input discussed in Chapter 5 (including guiding document), and considered the goals of this study, the need for balancing competing needs in the street space, and the various design elements of a potential at grade or grade-separated urban boulevard.

- Route 1 at grade with 15th Street S and 18th Street S
- Route 1 grade-separated at 15th and 18th Streets, mimicking the Sector Plan concept
- Existing grade-separated Route 1 with lower-cost enhancements

VDOT Route 1 Multimodal Improvements Study | Phase 1 **Draft Report**

## 6.1. Consideration of Study Purpose and Goals

The concepts were developed, screened, and refined with the intent to meet the purpose of this study, i.e., to identify enhanced multimodal connectivity and accommodations along and across Route 1 in Crystal City to meet the changing transportation needs of this growing urban activity center. In addition, the development of concept designs and the subsequent analyses considered the goals of this Route 1 Multimodal Improvements study, as described below.

- **Safety.** To improve safety along the Route 1 corridor, a multifaceted approach was taken. The design of each alternative included a reduced speed along Route 1 in which the speed limit would be reduced from a 35-mph speed limit to 30 mph, which would need to be determined following a speed study. A reduced speed limit will improve safety for bicyclists, pedestrians, and vehicular traffic. The at grade concepts included additional horizontal curvature in the roadway to further encourage reduced speeds along Route 1 as compared to a straight alignment. Additional bicycle and pedestrian features include bike lanes on 15th and 18th streets, median refuges (for at grade configurations), and bicycle/pedestrian ramps (grade separated) designed to create a safer and more inclusive space for bicyclists and pedestrians in the corridor.
- **Multimodal Accessibility and Accommodation.** The development of concepts for improvements along Route 1 focuses on accessibility and accommodation. Both the at grade and grade-separated concepts feature ADA-compliant bicycle and pedestrian facilities along Route 1, including a minimum 20-foot-wide pedestrian zone along Route 1 to facilitate potential forms of off-road travel including scooters, bicycles, and pedestrians, as well as wide pedestrian crosswalks and marked bicycle crossings. The entire corridor also will be upgraded to meet the latest ADA standards to provide accommodations such as audible pedestrian signals, longitudinal and cross slope considerations, and detectable warning surfaces. The grade-separated Sector Plan concept would include elevators, ramps, and stairs to facilitate movement of all non-vehicular modes between the elevated Route 1 and at-grade 15th and 18th Streets.
- **Transit Effectiveness.** As a part of the conceptual design and in accordance with the Sector Plan, this project will look to increase transit effectiveness and reduce vehicular trips. The project proposes to increase transit effectiveness through improved bus operations along Route 1 by improving reliability. Significant bicycle and pedestrian improvements along Route 1 will further enhance transit effectiveness by creating safer and more convenient access to Metrorail and to bus stops. The at-grade concepts would also include a new intermodal transit facility adjacent to the Crystal City Metro Station consistent with the Sector Plan to improve bus and /metro effectiveness.
- **Vehicular Operations.** To accommodate the existing and projected traffic along Route 1 and side streets, the approach to design of the improvements was to facilitate acceptable vehicular operations while providing a multimodal corridor with a thriving urban feel. Concepts for vehicular operations, such as the number of turn lanes, were developed to balance the needs of vehicles with those of pedestrians, bicyclists, non-auto users, and transit, considering through and local vehicle demands.

- Environment.** To preserve, protect, and enhance the built, natural, visual, and social environments, the Route 1 improvement concepts include environmental features, including green spaces in the form of grassed medians with trees, pedestrian zones on either side of Route 1 with street trees providing a natural and visually-appealing environment. The concepts also enhance the environment by reducing the total amount of pavement that exists today and replacing it with green space. This transition from pavement to green space would greatly improve the stormwater runoff and water quality along the Route 1 corridor. To improve both the built and social environment, the enhanced pedestrian zone will provide a new space along the Route 1 corridor for all modes of non-vehicular transportation to interact and travel to destinations along the corridor, including new buildings proposed to front this space. In addition, it would be VDOT's intent to implement a biophilic approach to the design and integrate natural features into Route 1, which in its current condition is largely asphalt and concrete.
- Urban Fabric.** To integrate Route 1 within the context of Crystal City and Pentagon City as a multimodal urban boulevard, both the at-grade concept and the grade-separated Sector Plan concept would provide that integration, but in different ways. The at-grade concepts remove the barrier that is currently this freeway segment of Route 1 and integrates the street into the surrounding Crystal City and Pentagon City. Further, an at-grade Route 1 would allow the redevelopment of additional land along the corridor for new development to front Route 1 and the pedestrian zone. The grade-separated Sector Plan concept would better integrate future land uses, but the barrier of an urban freeway would remain.

## 6.2. Balancing Competing Needs in the Street Space

In the development of workable concepts for Route 1, VDOT looked to find the optimal combination of elements that enhance safety and efficiency for all users. The current roadway places a priority on the movement of automobiles through a six-lane, grade-separated highway, but lacks sufficient pedestrian and bicycle facilities. A balanced approach to developing concepts prioritizes pedestrian and bicyclist safety and connectivity, transit efficiency, and vehicular movements, while providing flexibility for the future development of National Landing. Thus, from a concept design perspective, balancing competing needs involves trade-offs. Within the street cross section, these trade-offs include pedestrian crossing distances, pedestrian refuge width, consideration of a two-phase pedestrian crossing, traffic congestion, and even land for future development.

From a pedestrian perspective, travelling along Route 1 can be challenging. The road has no pedestrian facilities from 20th to 12th streets on the east side and a narrow sidewalk on the west side with little to no separation from traffic. To cross Route 1 and reach the Crystal City Metro station, pedestrians and cyclists may use the underpass at 18th Street for conflict-free travel. However, on 15th Street S, the multiple crossings of the interchange ramps are challenging for bicycle and pedestrian movements. Ideal pedestrian facilities along Route 1 would be comfortable, convenient, and provide greater opportunities to interact with existing and planned development.

Drivers also must be accounted for in an urban boulevard streetscape. The study area of Route 1 acts as a major thoroughfare for trips originating both in and around National Landing and regionally, in concert with parallel north south facilities of George Washington Parkway and I-395. Based on conclusions described earlier in this study and the Sector Plan, three travel lanes in each direction provide adequate mobility for vehicles through and within the area during peak periods. There is the potential that a future boulevard could convert the outside lane to on street parking during off-peak periods to help create a lively street.

Although there are some right-of-way constraints within the study area, much of the current roadway is bordered by undeveloped land. The design elements described in the next section are intended to make the optimal use of the available land while not precluding development of potential excess right-of-way resulting from the conversion of Route 1 to an urban boulevard.

### 6.3. Cross Section Elements and Design Criteria

In the development of multiple concepts for an at-grade and grade-separated Route 1, the following elements and design criteria were used to development concepts that met study goals:

- **Pedestrian Zone:** This element is the focal point of the Route 1 streetscape, made up of pedestrian walk area, landscaping, human-level lighting, benches, and space for outdoor café seating. Creating a wide, flexible space between the street curb and future development at this point in the study provides options in the future for what would best meet the needs of the community moving forward. This zone was initially designed to be a minimum width of 20 feet but would vary until new developments are complete.
- **Wide Sidewalks:** The pedestrian zone centers around wide sidewalks and the ability of pedestrians to move freely through the corridor. Sidewalks could range anywhere from 8–20 feet depending on the proposed uses within the pedestrian zone of the cross section.
- **Street Trees and Landscaping:** To create the feeling of an urban boulevard, trees, grass, and other landscaping would be placed in the median and between the curb and the sidewalk. This landscape strip will have the added benefits of providing a safety buffer between cars and people as well as creating a space for streetlights and other utilities where they would not impede movement of people.
- **Building Facades:** In the ultimate condition, it is anticipated that building facades will be adjacent to the sidewalk as in many urban environments and consistent with the Sector Plan. As a living part of the streetscape, business owners could work with VDOT and Arlington County on approvals to use part of the sidewalk as outdoor seating or dining space.
- **Bicycle Facilities:** While bicycle routes will be added on streets crossing Route 1, and continue to be improved on parallel routes, no bicycle facilities were included along Route 1 consistent with the Sector Plan. However, cyclists were still considered within the streetscape and would be able to make use of the wider sidewalks separated from automobile traffic. Further, the wide pedestrian zone could be used to implement a bicycle facility along Route 1 should the county choose to do so in the future.

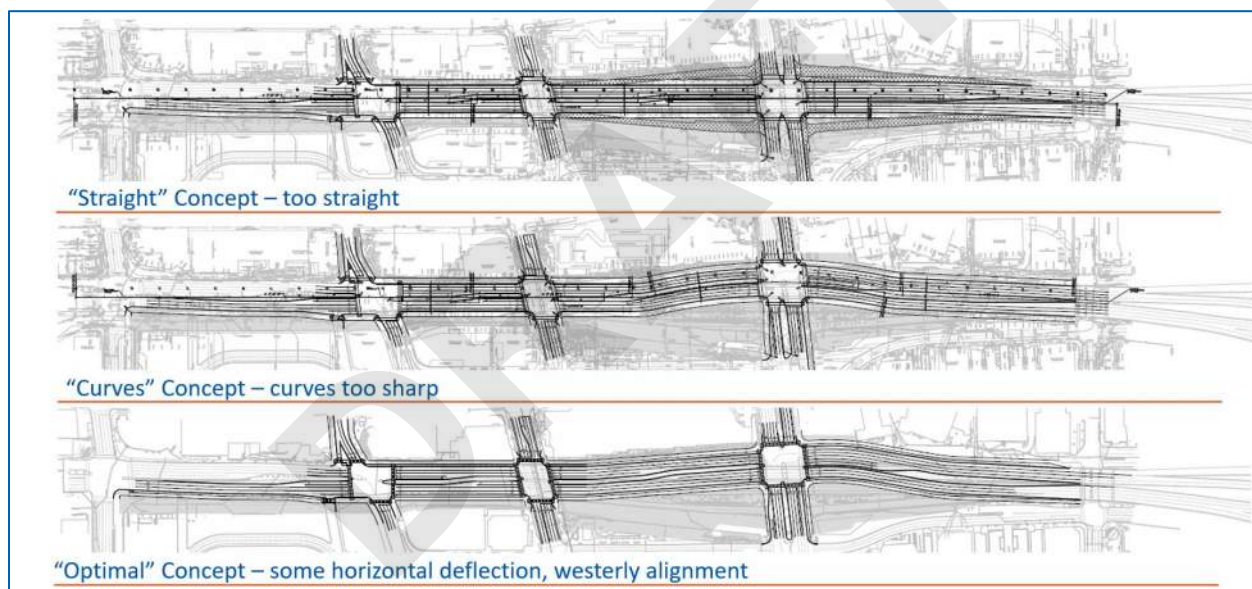
- **Medians:** To further enhance aesthetics and pedestrian safety, medians were considered along the length of the study area. Street trees would be planted in the medians as a measure to slow traffic and add to a more natural and comfortable streetscape. Although the intent of the at grade concept designs is for Route 1 to be crossed in a single cycle, the presence of medians would also provide a 10-foot wide refuge as an added safety measure for those unable or uncomfortable with crossing in a single phase.
- **Travel Lanes:** The concept plans for Route 1 assumed three through lanes in each direction to meet existing and future traffic and transit demands. The outside lane could be used in the future as an off-peak on street parking lane. To safely move the trucks and buses through the area, an 11-foot lane width was selected.
- **Turn Lanes:** After much consideration following stakeholder input and coordination with Arlington, the concept designs removed turn lanes where possible to provide shorter crossing distances for pedestrians and improve safety. The at grade concepts moving forward include shared right-through lanes instead of dedicated right-turn lanes.
- **Design Speed:** The design speed used for concept development was 30 mph. The proposed roadway speed limit would be reduced to 30 mph, which would need to be determined based on a speed study. It is VDOT's intent that geometric features combined with the other elements discussed above would encourage lower speeds and improve safety for all users. The primary geometric features used to slow traffic would include multiple low-speed curves that push the roadway to the west and reduce the footprint of the roadway. Other elements such as street trees, streetlights, well-marked pedestrian and bicycle crossing, signs, and traffic signals would serve to slow vehicle speeds.
- **Corridor Width:** The Sector Plan defined the width of corridor—the distance between building faces in the final condition where the roadway would be located—as 140 feet for an at-grade option and 160 feet for a grade-separated option. These widths would remain consistent in each option and through the length of the corridor. Maintaining a constant width provides flexibility for development in the future of the potential excess right-of-way resulting from the conversion of Route 1 to an urban boulevard.
- **Utilities:** In the past, a large number of utilities were consolidated under the now-demolished S Clark Street alignment. To prevent conflict with future development, utilities are proposed to be relocated to the Route 1 corridor. This project assumes the relocation and construction of a dry utility duct bank located under the future sidewalk, while gas, waterline, storm sewer, and sanitary sewer lines will be located under the roadway. Relocation of the utilities from the existing Clark Street alignment provides space for future redevelopment within the abandoned Clark Street alignment.
- **Urban Design Guidance:** American Association of State Highway and Transportation Officials (AASHTO) *Policy on Geometric Design of Highways and Streets*, National Association of City Transportation Officials (NACTO) *Urban Design Guide*, the VDOT *Road Design Manual*. These guides developed features such as reduced speeds (30 mph), tighter curb radii, reduced lane width, trees and landscaping, medians and curb extensions, and potential for future on-street parking and bike lanes along Route 1.

## 6.4. Initial Concept Development

For the development of initial concepts for a Route 1 urban boulevard, the study team examined various alignments, cross sections, and intersection lane configurations for both at grade and grade-separated configurations, considering the study goals, balancing the needs of all potential travelers, and the cross section elements and design criteria.

### 6.4.1. Alternative At-Grade Alignments

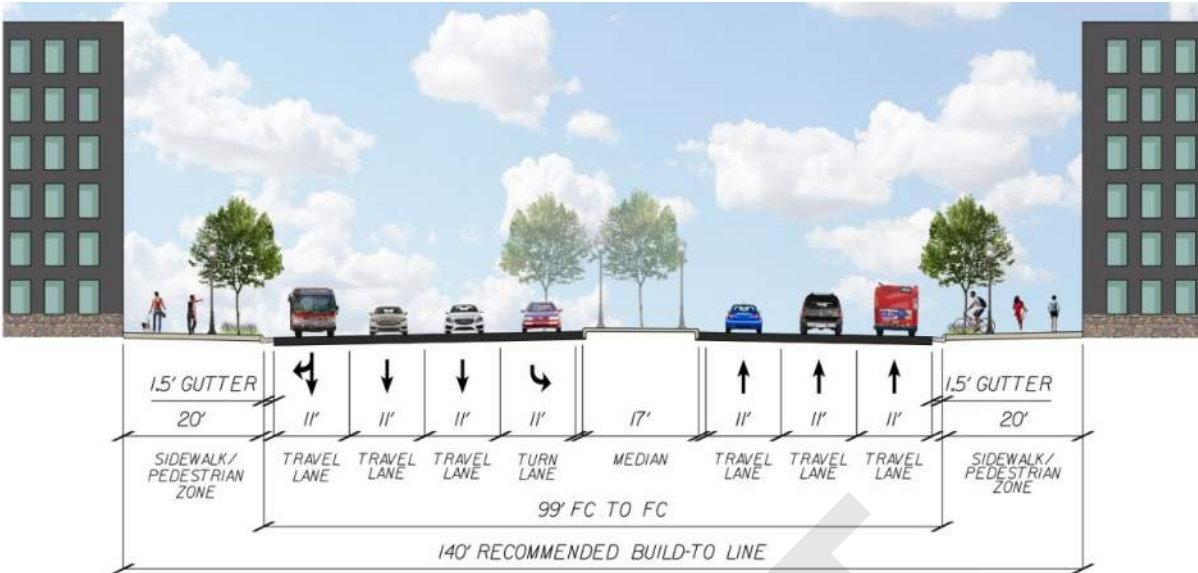
When initially screening the at-grade scenarios, three alternative alignments were considered—one as a straight line following the existing Route 1 centerline; a second including curvature to the west using the sharpest radii allowed per the *VDOT Road Design Manual*; and a third which curves more gently to the west, horizontally meeting the 40-mph design speed criteria. The third more gentle curving scenario was selected as the preferred alternative for two reasons—first, the horizontal curvature would assist in reducing speeds, especially for southbound traffic coming from I-395; and second, the horizontal curvature would not be so extreme as to misalign with driver expectations and create safety concerns. These various alignments are shown in **Figure 6-2**.



**Figure 6-2 Alternative Route 1 At-Grade Alignments**

### 6.4.2. Initial At-Grade Cross Section

Accompanying the development of an optimal at-grade alignment, the study team examined potential cross sections for an at-grade urban boulevard, given the cross-section elements discussed above and the potential future multimodal traffic and transportation conditions. **Figure 6-3** shows this initial at-grade cross section of Route 1 at 15th Street S. Note that future development of the adjacent land is shown as well.



**Figure 6-3 Initial Route 1 Cross Section at 15th Street (Looking North)**

#### 6.4.3. At-Grade Profile

With a selected alignment and utilizing topography from survey collected by VDOT, a profile of the existing ground features was developed. Based on the existing ground profile, a proposed grade profile was created to identify if and how to feasibly bring Route 1 down from 12th street to existing grade at 15th street to maintain an at-grade corridor south to 20th street. Review of the existing ground found that the elevation of Route 1 from 12th Street to 15th Street could be feasibly lowered within the design criteria listed above. The profile for the at-grade configuration was then refined to develop a profile that would be sound from a hydraulic and runoff standpoint in which low points can be drained and to keep vertical curves outside of the intersections. The at-grade profile is shown with the concept plan in **Figure 6-4**.

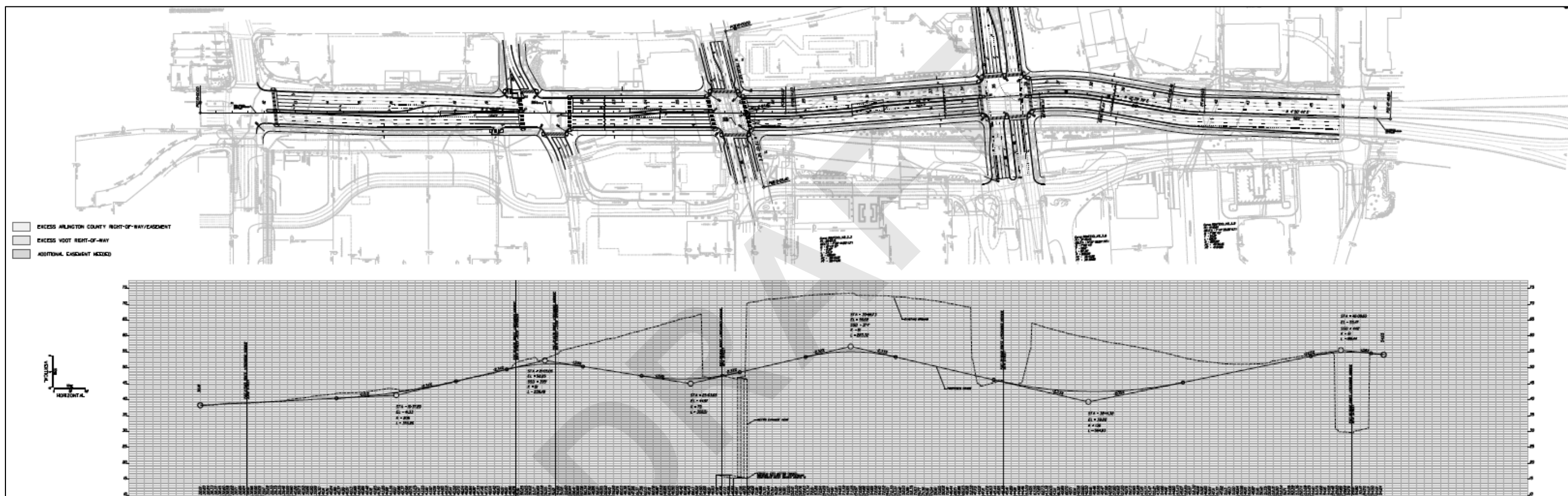
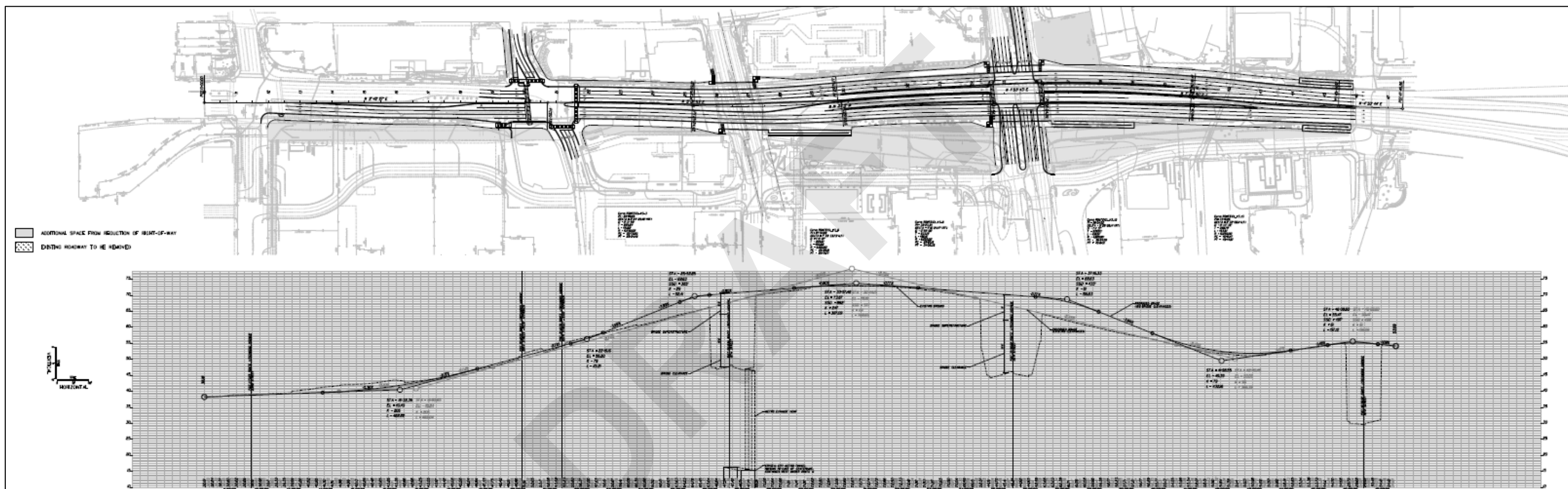


Figure 6-4 Concept Plan and Profile for At-Grade Concept

#### 6.4.4. Grade-Separated Sector Plan and Profile

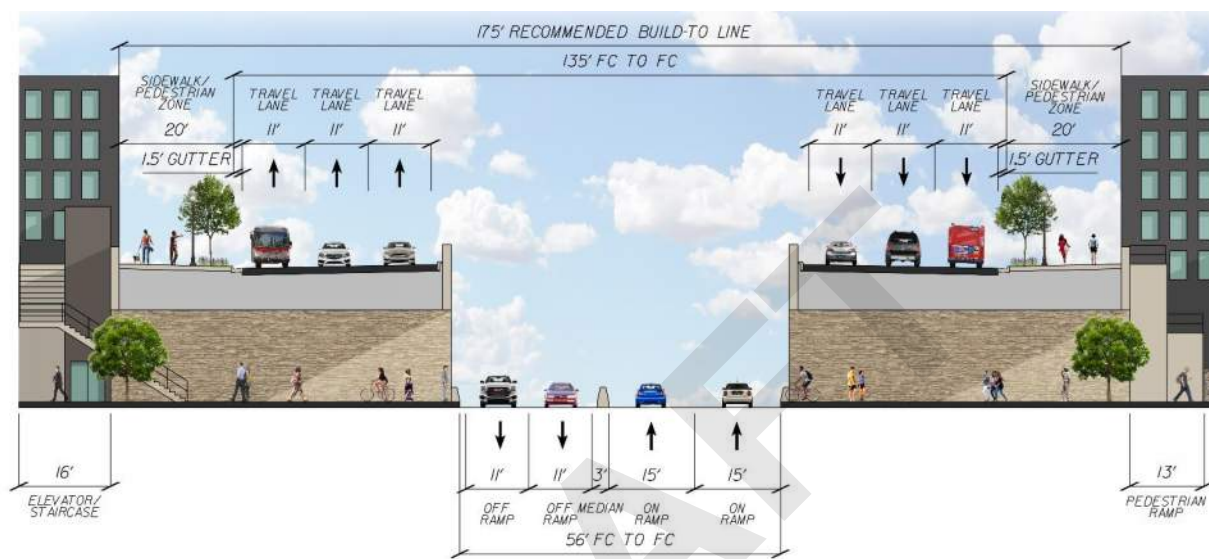
The feasibility of an alignment for a grade-separated concept was analyzed in the same way as the at-grade concept design. In this case, only one alternative was analyzed for the Sector Plan's "reverse" single point urban interchange (SPUI) in which the ramps are on the inside of the interchange (vs. outside in a more traditional SPUI) creating a single intersection at 15th Street S rather than the two intersections that exist today. The grade-separated concept alignment maintained the same alignment as the at-grade concept; however, the profile was clearly different. **Figure 6-5** shows this possible plan and profile for the grade-separated concept.

It should be noted that during the existing conditions analysis, it was found that neither the 15th Street S nor 18th Street S bridges provided the required vertical clearance per VDOT standards. As such, to keep a grade-separated scenario with a new interchange, the proposed profile would have to be raised approximately 5 feet to provide the required vertical clearance of 16.5 feet. The profile shown below depicts the proposed elevation change that would be necessary to elevate Route 1 enough to provide the required minimum vertical clearance. Based on the proposed profile it was found that the grade-separated scenario would be feasible and within the design criteria for the project. However, vertical geometry for the SPUI ramps was not analyzed, and feasibility of the SPUI itself would require further feasibility analysis.



#### 6.4.5. Initial Grade-Separated Cross Section

With the development of a grade-separated alignment, the study team also examined potential cross sections for the Sector Plan's version of urban boulevard. A typical cross section is shown in **Figure 6-6**. Note that to achieve pedestrian and bicycle connectivity between Route 1 and 15th Street S (or 18th Street S), ramps, stairs, and elevators would be required. Future redevelopment could provide some of this connectivity.



**Figure 6-6 Initial Grade-Separated Cross Section**

#### 6.5. Concept Screening

With initial concepts developed, the study team developed and screened variations of these concepts considering stakeholder and public input, especially from PIM #2 in March 2020, as well as current and future year traffic, and design and construction feasibility.

##### 6.5.1. Stakeholder and Public Input

As discussed in Chapter 5, this Route 1 Multimodal Study included multiple stakeholder and public meetings for VDOT to receive input and guidance related to the scenarios. Design and traffic analysis elements were presented to the public for comment and review. The input provided additional scenarios and ideas to consider for the feasibility analyses. Additional considerations included modifying the typical sections to minimize turn lanes and the total number of lanes across Route 1, a widened landscaped median, and an additional at-grade configuration (Concept 3, discussed below). Additionally, the public input identified the need to further study and develop potential options for a non-auto underpass or overpass for crossing Route 1 at 18th Street in the at-grade scenario.

##### 6.5.2. Design Feasibility

The feasibility of the design and implementation of each of the potential configurations also was analyzed. The design feasibility concept screening identified constraints based upon the

American Association of State Highway and Transportation Officials (AASHTO) *Policy on Geometric Design of Highways and Streets*, National Association of City Transportation Officials (NACTO) *Urban Design Guide*, the VDOT *Road Design Manual*, the *Virginia Work Area Protection Manual*, and the VDOT *Road and Bridge Standards*. The at-grade and grade-separated configurations used the VDOT *GS-5 Geometric Design Standards for an Urban Principal Arterial* for a 30-mph design speed. The design screening verified that the at-grade and grade-separated Sector Plan concepts were all feasible alternatives that could be constructed to VDOT design standards.

### 6.5.3. Traffic Operations Screening

In addition to screening for design and constructability, a high-level review of the impact to traffic operations was conducted for several iterations of initial design concepts. These iterations included exploring the impact of dedicated versus shared right-turn lanes, the number of left turn lanes needed, the number of through lanes along Route 1, and various turn restrictions. A conservative screening analysis was conducted using the 2025 and 2040 AM and PM peak hour traffic forecasts provided by Arlington County, with some localized reassignment in the study area as needed. These traffic volumes were consistent with those described in Chapter 4, which conservatively assumes that the traffic volumes along Route 1 would continue to increase and be consistent with those for the grade-separated, no build scenario.

Traffic operations were screened at a high-level using Synchro software looking at overall intersection delay and LOS. **Table 6-1** shows the results of this screening analysis. As shown, the at-grade concepts generally show high delays, especially at the Route 1/15th Street S intersection during the AM peak hour.

**Table 6-1 Screening Analysis Results**

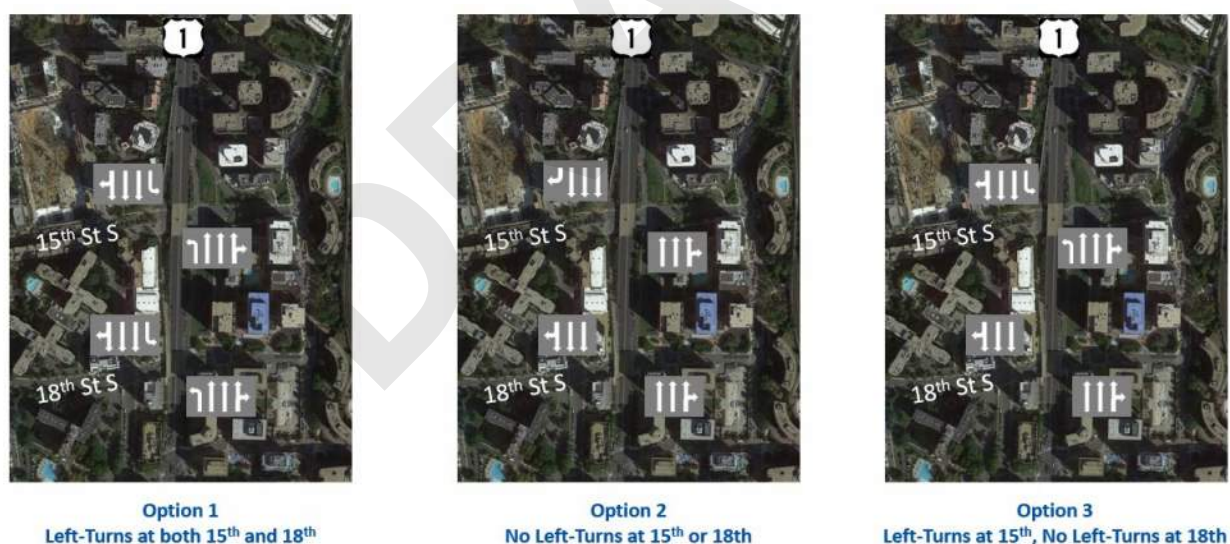
	Scenario Name	ST	SB	NB	2025 AM		2040 AM		2025 PM		2040 PM	
					15th	18th	15th	18th	15th	18th	15th	18th
	At-Grade Concept A: Dual SB Lefts, Single SB Right @ 15 <sup>th</sup> (9 lanes)	15 <sup>th</sup>			F (82 s)	D (48 s)	F (180 s)	F (122 s)	D (47 s)	D (36 s)	F (82 s)	D (49 s)
		18 <sup>th</sup>										
	At-Grade Concept B: Single SB Left & Right @ 15 <sup>th</sup> (8 lanes)	15 <sup>th</sup>			F (135 s)	D (48 s)	F (217 s)	F (122 s)	D (48 s)	D (36 s)	F (95 s)	D (48 s)
		18 <sup>th</sup>										
	At-Grade Concept C: Single Left & Shared Thru/Right (7 lanes)	15 <sup>th</sup>			F (137 s)	D (50 s)	F (221 s)	F (122 s)	F (83 s)	D (33 s)	F (162 s)	D (47 s)
		18 <sup>th</sup>										
	At-Grade Concept D: Dual SB Lefts, Single SB Right @ 15 <sup>th</sup> (9 lanes); no LT @ 18 <sup>th</sup>	15 <sup>th</sup>			F (124 s)	C (23 s)	F (168 s)	C (32 s)	E (56 s)	C (20 s)	F (95 s)	C (21 s)
		18 <sup>th</sup>										
	At-Grade Concept E: Concept A w/ 2 Thru Lanes on Rte 1 (7 lanes)	15 <sup>th</sup>			F (119 s)	E (74 s)	F (228 s)	F (154 s)	E (56 s)	E (60 s)	F (100 s)	F (103 s)
		18 <sup>th</sup>										
	At-Grade Concept F: Concept A w/ No Left Turns at 15 <sup>th</sup> /18 <sup>th</sup> (7 lanes @ 15 <sup>th</sup> , 6 lanes @ 18 <sup>th</sup> )	15 <sup>th</sup>			D (47 s)	D (39 s)	F (102 s)	F (81 s)	C (30 s)	D (40 s)	D (44 s)	D (51 s)
		18 <sup>th</sup>										
	Sector Plan Concept: Inverted SPU				Not Analyzed Yet	N/A	C (23 s)	N/A	Not Analyzed Yet	N/A	D (43 s)	N/A

With respect to Table 6-1, the conventional four-way intersections show lots of “red” with the design volumes. A more traditional solution to overcome this congestion would be to add turn lanes; however, given the feedback from stakeholders and the public, adding turn lanes (especially double left turn lanes) was not an option. Multiple left turn lanes are not conducive to pedestrian safety, nor are right turn lanes. Thus, based on this feedback, VDOT selected a maximum of seven lanes for the Route 1 legs of the intersections with 15th Street S and 18th Street S.

Thus, and the study team moved forward with the following concepts:

- Concept C (all turning movements permitted at 15th and 18th Streets), which became At-Grade Option 1
- Concept F (left turns from Route 1 prohibited at 15th and 18th Streets), which narrowed the Route 1 typical section to 6-lanes providing a wider center median with additional plantings possible, and which became At-Grade Option 2
- Concept G, a “hybrid” concept of Concepts C and F (left turns at Route 1/15th Street, no left turns at Route 1/18th Street) included at request of Arlington County staff, which became At-Grade Option 3

The intersection configurations for these three at-grade concepts are shown in **Figure 6-7**.



**Figure 6-7 Intersection Laneage for At-Grade Configuration Options 1, 2, and 3**

#### **6.5.4. Other Concepts Considered but Not Analyzed**

Throughout the concept development process, the design team received input from the public, Arlington County, and VDOT to evaluate other conceptual design ideas for the Route 1 corridor for preliminary feasibility review. These ideas were:

- At-grade intersection at 15th Street with grade separated overpass of 18th Street
- Route 1 tunnel beneath existing 15th Street and 18th Street
- Route 1 one-way pair

The conceptual option to make 15th Street at-grade and keep 18th Street grade separated presented design issues which were not feasible for further conceptual design and analysis. The first major issue was the “roller coaster-like” profile with 12th and 18th streets elevated and 15th and 20th streets at-grade. Second, with the continuous change between at-grade and elevated, the profile grades become steeper than allowable per VDOT design guidance.

The idea to make Route 1 a tunnel beneath the existing cross streets of 15th and 18th streets was determined to not be feasible for various reasons—the first and largest issue being that it would conflict with the existing underground Crystal City Metro station and tunnel, as well as the vent shaft at 18th Street S. The second issue being underneath 15th Street, the profile grades to elevate back up to 12th Street were steeper than allowable per VDOT design guidance. Still a third issue was that this tunnel option would necessitate the removal of the existing pedestrian tunnel under Route 1 between the Crystal Gateway Marriott and the Crystal City Shops.

Conversion of Route 1 to a pair of one-way streets was determined to be feasible, but not to a degree that would provide substantial benefits over the at-grade concepts discussed in this report. Due to the limited right-of-way from 20th Street S to 18th Street S, and VDOT design guidance for roadway curvature, the available distance between the two one-way streets would be minimal and unsuitable for development.

Because of preliminary design issues identified through the design screening process, these three scenarios were not taken further in this feasibility study.

#### **6.5.5. Other Design Options Not Precluded**

The at-grade and grade-separated conceptual designs were developed such that they do not preclude other future scenarios and alternatives that may take place. While not depicted on the concept plans, as the urban nature of the Route 1 corridor intensifies, potential options could be incorporated in the Route 1 by reallocating the cross-section space. These options could include on-street parking during non-peak hours, bicycle facilities along Route 1, and bus-only lanes on Route 1. Further, the Route 1 improvements would not impact the ability for future improvements north or south of the corridor study area (e.g., modification of the Route 1 at I-395 interchange).

### **6.6. Conceptual Designs for Feasibility Analysis**

The conceptual designs were further developed so that the VDOT study team could examine the feasibility and scope of each scenario as well as develop more refined approaches to

construction phasing and estimates of project costs. The conceptual designs were based on guidelines from the VDOT *Road Design Manual* and related standards, as well as the typical sections and other concepts from the Sector Plan. Conceptual designs began by using mapping from the county's geographic information system (GIS) database combined with VDOT survey of the corridor and progressed with a conceptual plan—including a plan and profile for the project to gather more detailed information for cost estimating and feasibility purposes (also called line and grade plans). Combined with the project at-grade cross section and typical Sector Plan cross section, a roadway prism was developed for estimating limits of disturbance. Logical termini were developed for each of the road segments and intersections. Bridge and culvert crossings were identified and preliminarily sized. Additional items such as traffic signals were considered. Field observations were also conducted to confirm the mapping, verify assumptions, and to check the feasibility of the conceptual designs.

The following general assumptions were made for each of the concepts where applicable:

- Stormwater management facilities were assumed not to be necessary as described in Section 5 of this report. Stormwater inlets and culverts were assumed but not identified in the conceptual plans for future design and consideration.
- Large drainage structures were assumed to cross the entirety of the Route 1 corridor; however, the structure type was not determined at this stage of design.
- Right-of-way needs were assumed to be based on the Sector Plan requirements for each concept plan. Additional right-of-way was provided as necessary for proposed stormwater management facilities and large drainage structures.

#### **6.6.1. At-Grade Configuration – Option 1**

Option 1 would create an at-grade urban boulevard by replacing the overpass at 18th Street S and the interchange at 15th Street S with at-grade intersections and prioritizing improvements to pedestrian facilities. By lowering Route 1 to be at-grade, pedestrian (and bicycle) connections can be created from 15th Street S and 18th Street S to new north/south pedestrian avenues through the center of Crystal City. The sidewalk space along both sides of Route 1 would be separated from vehicular traffic by street trees and other landscaping. While elements behind the curb would help to make the corridor more traversable and welcoming, they also would help to slow traffic.

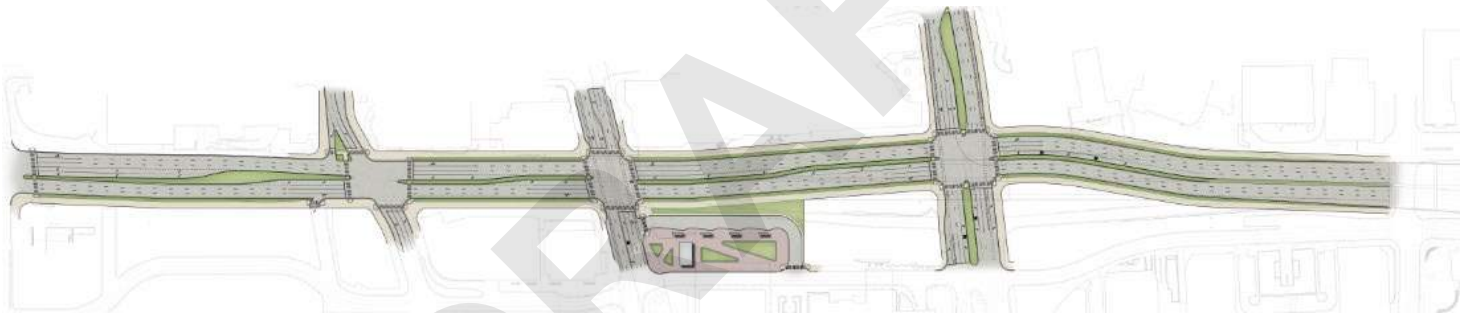
Route 1 itself would maintain the same footprint from 20th Street S to 18th Street S and shift to the west between 18th Street S and 12th Street S approximately where the western on/off ramps are located today. The current alignment and cross section of Route 1 (long, straight sections, wide lanes, shoulders) leaves drivers with the ability to travel well above the posted speed limit. Adding low-speed curves before and after intersections encourages vehicles to reduce their speed. The shift also has the benefit of creating additional land for development along a future Route 1. Three travel lanes would remain in each direction, with a maximum of one left-turn lane added at intersections.

This option would use traditional intersections at both 15th and 18th streets, with all turning movements allowed. A landscaped median with planted trees would be implemented through the entire corridor to provide a greener space overall as well as a pedestrian refuge at intersections. Overall, Option 1 would provide the most straightforward experience for all users of the roadway and provide flexibility for development in the future.

Key Elements of Option 1 include:

- 24-foot-wide pedestrian zone including street trees, landscaping, and wide pedestrian spaces
- Minimum 10-foot-wide landscaped median through the corridor, including 10-foot-wide pedestrian refuges at intersections
- Seven-lane cross section at 15th, 18th, and 20th streets with no dedicated right-turn lanes
- Left turns are permitted at every intersection

**Figures 6-8 through 6-11** show renderings of the at-grade Concept 1 configuration.



*Figure 6-8 Plan view rendering of At-Grade Option 1 with multimodal transfer station at Crystal City Metro Station*



*Figure 6-9 Rendering of Option 1 – Route 1 at 15th Street S (Looking West)*



*Figure 6-10 Rendering of Option 1 – Route 1 at 15th Street S (Looking North)*



*Figure 6-11 Rendering of Option 1 – Route 1 at 18th Street S (Looking Northwest)*

#### **6.6.2. At-Grade Configuration – Option 2**

The design of Option 2 is very similar to Option 1. The overpass at 18th Street S and the interchange at 15th Street S would be converted to at-grade intersections; wide sidewalks with access to new developments would be provided on both sides of Route 1; and the roadway would follow the same alignment as Option 1. Landscaping and trees would be used in the pedestrian zone and in the median to create green space and slow traffic and would generally create the same look and feel for users.

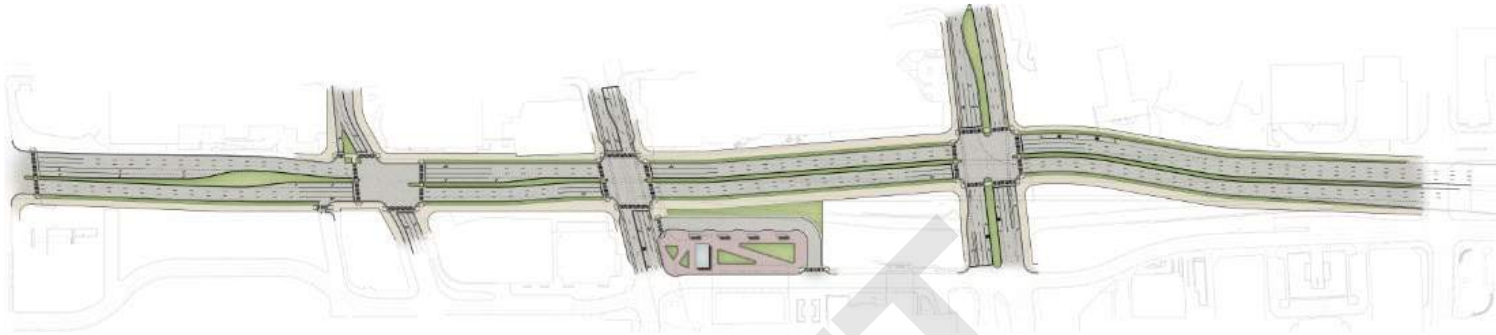
Option 2 differs from Option 1 by removing the ability to make left turns from Route 1 onto 15th Street S and 18th Street S. Since Route 1 will occupy a 140-foot-wide corridor regardless of what option is chosen, removing turn lanes along Route 1 will create more space for other users, primarily pedestrians. The lane reduction means that pedestrians walking along both sides of 18th Street S and on the south side of 15th Street S will have an easier and more comfortable time crossing Route 1. Less space in the corridor taken up by pavement also means that more space can be dedicated to walkability, green space, and the local community.

Key Elements of Option 2 include:

- 30-foot-wide pedestrian zone including street trees, landscaping, and wide pedestrian spaces
- Minimum 10-foot-wide landscaped median through the corridor, including 10-foot-wide pedestrian refuges at intersections

- Six-lane cross section at 18th street, with seven-lane cross sections at 15th and 20th streets
- Left turns from Route 1 are only permitted at 20th Street S (and 23rd Street S); a dedicated right-turn lane is implemented at 15th Street S

**Figures 6-12 through 6-15** show renderings of the at-grade Option 2 configuration.



*Figure 6-12 Plan view rendering of at-grade Option 2 with multimodal transfer station at Crystal City Metro Station*



*Figure 6-13 Rendering of Option 2 – Route 1 at 15th Street S (Looking Southwest)*



*Figure 6-14 Rendering of Option 2 – Route 1 at 18th Street S (Looking North)*



*Figure 6-15 Rendering of Option 2 – Route 1 at 18th Street S (Looking South)*

### 6.6.3. At-Grade Configuration – Option 3

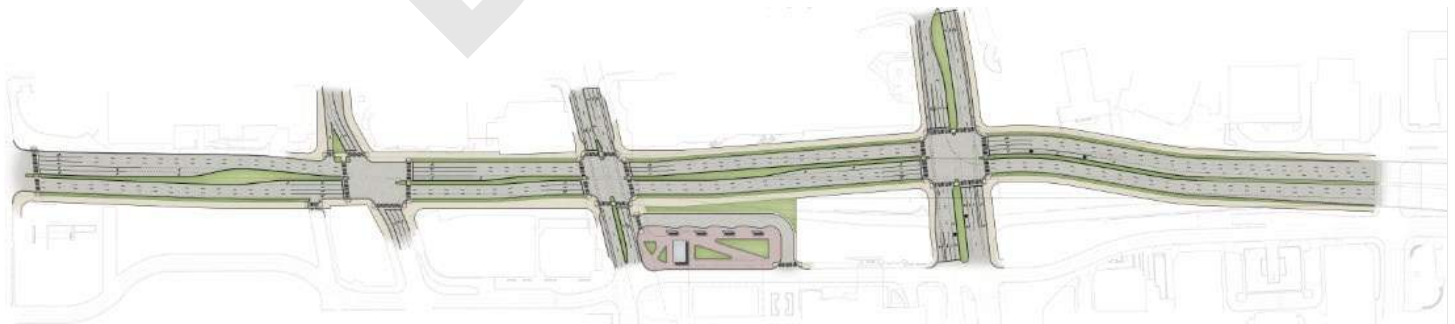
The third at-grade option keeps the core components of Options 1 and 2. At-grade intersections would be created at 15th Street S and 18th Street S; wide pedestrian zones with landscaping, trees, and lighting would line both sides of Route 1; and the roadway would generally follow the same alignment.

In an attempt to improve traffic performance throughout the study area for an at-grade configuration, as well as improving the pedestrian experience accessing the Metro, this at-grade option is modeled similarly to how Route 1 operates today. The intersection at 15th Street S would allow turning movements in all directions, but the intersection at 18th Street S would not allow left turns from Route 1 or 18th Street S. This mix of intersection configurations means that the roadway will shift multiple times through the corridor, curving to slow down drivers and increase awareness of changing street uses. The elimination of turn lanes at 18th Street S would reduce crossing distances for pedestrians and create more walkable space around the Crystal City Metro station.

Key Elements of Option 3 include:

- Minimum 24-foot-wide pedestrian zone including street trees, landscaping, and wide pedestrian spaces
- Minimum 10-foot-wide landscaped median through the corridor, including 10-foot-wide pedestrian refuges at intersections
- Six-lane cross section at 18th Street S with seven-lane cross section at 15th Street S and 20th Street S and no dedicated right-turn lanes
- No left turns are permitted from 18th Street S to Route 1 or from Route 1 to 18th Street S; 15th Street S and 20th Street S maintain all turning movements

**Figure 6-16** shows the plan view rendering of the at-grade Option 3 configuration. The intersection renderings of 15th Street S for Option 1 and of 18th Street S for Option 2 would be the same for this “hybrid” Option 3.



**Figure 6-16 Plan View Rendering of At-Grade Option 2 with Multimodal Transfer Station at Crystal City Metro Station**

### 6.6.4. Sector Plan Concept

The Sector Plan concept would generally keep the Route 1 corridor in a similar configuration as it exists today with a grade-separated overpass at 18th Street S and an interchange with ramps

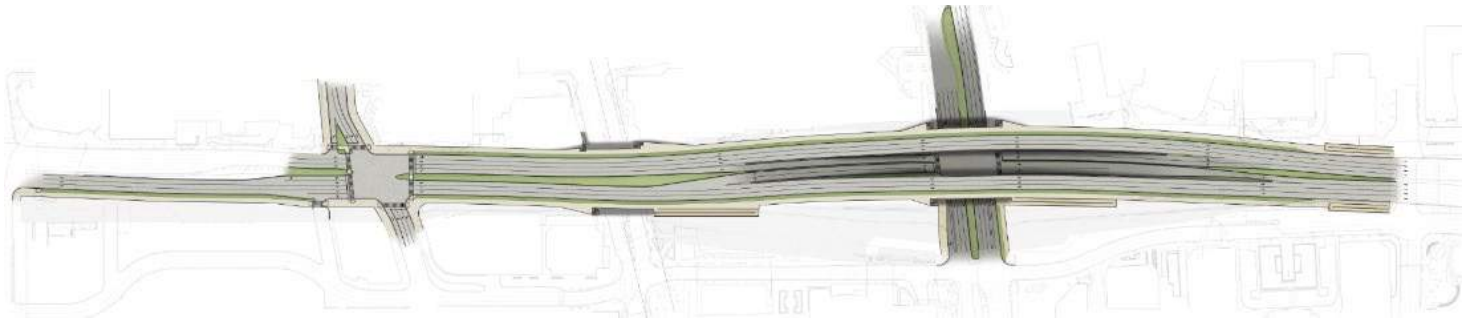
at 15th Street S. However, the Sector Plan concept would modify the interchange at 15th Street S to be a compact SPUI with ramps internal to the interchange. This “reverse SPUI” configuration reduces impacts to adjacent property, allowing more room for redevelopment, including development to the back of the sidewalk of the elevated Route 1. This concept also provides greater intersection spacing between the Route 1 and 15th Street S intersection as well as the Eads Street and Crystal Drive intersections. The Sector Plan concept also would raise the existing profile of Route 1 to provide the minimum clearance for bridges over 18th Street S and 15th Street S. In doing so, new parallel and pedestrian facilities are proposed along Route 1 to carry non-motorized users north and south along the corridor between 12th Street S and 20th Street S.

The Sector Plan concept would still create an urban boulevard by using the same elements as the at-grade options. Pedestrian zones with landscaping and wide sidewalks on both sides of the roadway would provide access to store fronts and restaurants located on the second levels of developments built adjacent to Route 1. The experience while moving along Route 1 would be similar to that of any at-grade boulevard. A combination of ramps, stairs, and elevators would move users to Route 1 from 12th, 15th, and 18th streets below, and could be replaced by similar features inside adjacent buildings in the future. Placing Route 1 traffic above grade creates additional protected space underneath for shelter and conflict-free travel at 18th Street S and reduces crossing distances at 15th Street S.

Key Elements of the Sector Plan concept include:

- Minimum 20-foot-wide pedestrian zone including street trees, landscaping, and wide pedestrian spaces
- 10-foot-wide landscaped median through the corridor
- Expanded overpass over 18th Street S to provide better pedestrian facilities
- Stairs, elevators, and ramps would provide access between Route 1 and its store fronts with 18th Street S and the newly improved Metro plaza below
- Conversion of the 15th Street S interchange into an inverted SPUI, reducing pedestrian crossing distances and increasing the amount of usable land around Route 1
- Three grade-separated travel lanes in each direction

**Figure 6-17** shows the plan view rendering of the Sector Plan concept.



*Figure 6-17 Plan View Rendering of Grade-Separated Sector Plan Configuration*

#### 6.6.5. Modified Existing Concept

A final option to consider for improving multimodal conditions on Route 1 would involve making incremental changes to existing Route 1 that don't require major reconstruction of the roadway. The improvements generally fall into three categories:

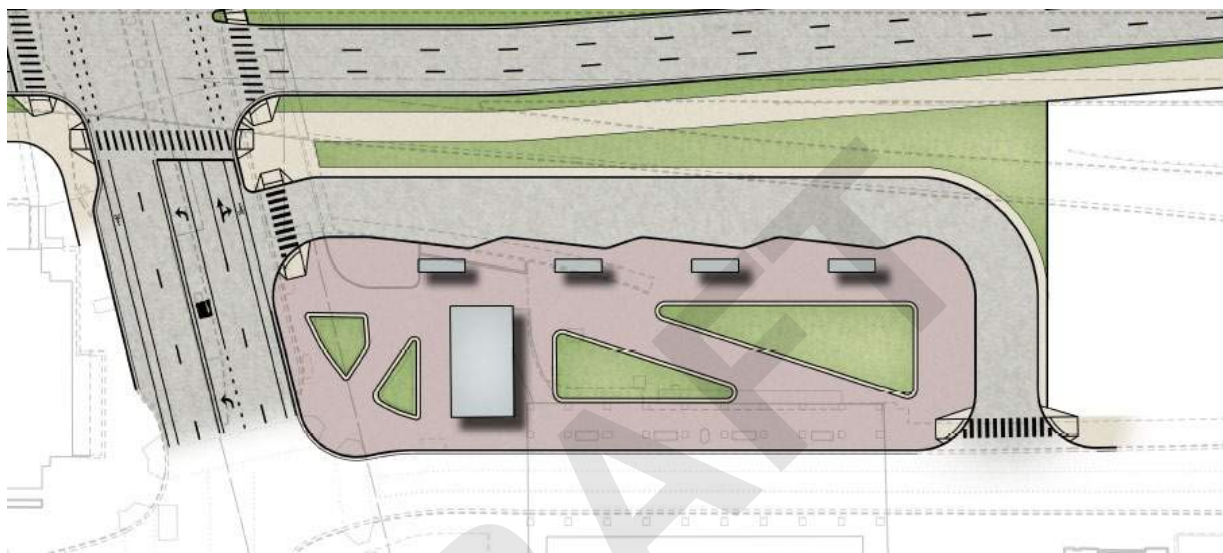
- **Safety:** Lowering the speed of vehicle traffic is desirable to improve safety for all users of the roadway. The speed limit could be lowered from 35 mph to 30 mph, which would need to be determined following a speed study. Speed feedback signs and other measures could be installed to make drivers aware of the changing environment. Rumble strips could further define the transition from freeway to urban boulevard, reducing the likelihood of a collision.
- **Streetscape:** Initially, pedestrian level lighting could be installed as opposed to the auto-centric lighting that exists today. Landscaping could be improved wherever possible; however, aesthetic and environmental changes would be largely left to future developers to implement. Buildings oriented towards Route 1 with widened pedestrian spaces along the roadway could be highly encouraged.
- **Mobility:** While mobility will be aided through upcoming projects in the surrounding area and by future developments, there are opportunities to increase walkability in the Route 1 Corridor. At 15th Street S, a westbound bike lane could be included to connect networks at Eads Drive and Crystal Drive. Sidewalk space also could be expanded by rebuilding the abutments of the 15th Street Bridge. Ramps, stairways, and elevators could connect Route 1 to the lower streetscape at locations most beneficial to the community, especially around the Crystal City Metro station.

For this option, it is important to note some or all the changes may be implemented to improve Route 1, but not necessarily at the same time. The sum of the listed improvements would create a meaningful change to the urban environment, but individually they can still add significant benefits.

#### 6.6.6. Multimodal Transit Facility (by others, per Sector Plan)

As part of the at-grade options, a multimodal transfer facility, as envisioned in the Sector Plan and centered around the current Crystal City Metro station, could replace existing bus stations on 18th Street S and serve to encourage people to use the bus transit mode of transportation.

The design of this facility would be largely based on the recommendations of the Sector Plan but will need to be examined further in future studies and coordinated closely with Arlington County. For the at-grade concepts, the proposed facility would have a bus loop that would ingress from 18th Street S and egress onto S Bell Street, largely maintaining current bus routes and preserving connectivity to the Metro station. As shown in **Figure 6-18**, multiple sawtooth bus bays would be surrounded by green space and plantings, creating additional green space in the urban center of Crystal City.



**Figure 6-18 Concept Plan of Intermodal Facility at Crystal City Metro Station**

#### **6.6.7. Reducing Speed of Southbound Traffic from I-395 and Route 110**

In rounding out the discussion of conceptual designs for a Route 1 urban boulevard, the study team shared with the Route 1 Task Force and the public at PIM #2 some ideas to slow traffic that is coming off of I-395 or Route 110 and heading south through Crystal City. Given that slower traffic speeds is a key to pedestrian safety, before vehicles reach 15th Street S in the at-grade concepts or 20th Street S in the Sector Plan concept, those vehicles should be going much closer to 30 mph.



This slowing of southbound vehicle traffic coming from Route 110 and I-395 could be done with education and enforcement measures, as well as active and passive measures.

- Education and enforcement measures:
  - Adding regulatory and warning signage for speed limit reductions in advance of 15th Street
  - Lowering the speed limit to 30 mph just south of 12th Street
  - Community coordination with police to develop enforcement strategies
  - Installing radar speed feedback signs, which tend to work better in areas with higher visitors (vs. commuters who get use to the signs)
- Periodic measures:
  - Rumble strips/grooved pavement
  - High visibility pedestrian (and bicycle) crosswalks
  - Leading pedestrian intervals
  - Intersection lighting
  - Sufficient crossing time for pedestrians
  - Bus stops
- Continuous measures:
  - Curves and other geometric features to slow traffic
  - Street trees and pedestrian lighting, both sides of travel lanes, prior to 12th Street overpass
  - Possible off-peak on street parking

All of these measures could combine to effectively slow southbound traffic before it reaches the first signalized intersection on Route 1 in Crystal City. Further, it is possible that when VDOT reconstructed the bridge from southbound I-395 to southbound Route 1, the new bridge could be designed with measures that slow traffic before arriving in Crystal City.



*Typical Radar Space Feedback Sign*

## **6.7. Conclusions on Concept Development**

The concept development process was a multistep approach to create, screen, and vet potential Route 1 multimodal improvements to result in a set of concept designs to be considered for refinement and further restudy. The screening process involved technical feasibility analysis based on the goals of this study to incorporate safety, multimodal access and accommodation, transit effectiveness, vehicular operations, and environmental features, all to fit within the urban fabric and context of Crystal City.

The screening process began with a preliminary traffic analysis to identify the feasibility of eight initial scenarios. From those eight scenarios, four concepts were considered feasible from a multimodal operations perspective— Options C, F, and G (ultimately, Options or Concepts 1, 2, and 3 respectively) and the Sector Plan concept. Additionally, multiple design scenarios were identified by stakeholders and the public, including a Route 1 tunnel beneath existing cross streets and a grade-separated 18th Street and at-grade 15th Street. Those two options were determined to not be feasible from a design perspective given elevation changes and conflicts with existing metro infrastructure.

At-grade concepts Options 1, 2, and 3 and the Sector Plan concept were then reviewed using survey data and roadway design standards to ensure design feasibility and constructability. The conceptual feasibility screening found that the three at-grade concepts and the Sector Plan concept were ultimately feasible for potential implementation. Those options were then further refined to incorporate environmental, accessibility, and additional safety features and are the subject of additional analyses discussed in the next chapter.

## 7. Concept Evaluation

The refined potential corridor concepts—at-grade Options 1, 2, and 3, the Sector Plan concept, and the modified existing conditions concept—were further evaluated for feasibility based on the following analyses:

- **Constructability:** Can these concepts feasibly be constructed with a sequence of construction that minimizes impacts to all modes of travel? What challenges exist for the design and construction process?
- **Stormwater Management:** Do these concepts result in an increase in stormwater runoff, or, if they show a decrease, does one concept do an optimal job of minimizing runoff?
- **Developable Land:** How much land would be reallocated for potential urban redevelopment adjacent to the corridor in each concept to align with the urban fabric of the National Landing area?
- **Planning-Level Cost:** What is the planning-level cost of each concept—accounting for preliminary engineering, construction, right-of-way, and utilities? How do these compare to each other?
- **Traffic and Safety:** What is the impact of each concept on multimodal traffic operations and safety along the Route 1 corridor? Is it reasonable to assume that traffic volumes would stay consistent or continue to grow if an at-grade concept is implemented?

### 7.1. Constructability and Sequence of Construction

Discussed below is the study team’s analysis of constructability of the at-grade and grade-separated concepts. Additional discussion and detail can be found in **Appendix B-1, Route 1 Feasibility Analysis Summary**.

#### 7.1.1. At-Grade Concept

The study team assessed the constructability of the three at-grade concepts and developed findings that could apply to any of the three proposed at-grade Options 1, 2, or 3. The following paragraphs discuss these findings with respect to impacts to structures and soils and an anticipated sequence of construction.

##### *Impacts to Bridges, Retaining Walls, and Soils*

The at-grade concepts would involve the removal of the existing Route 1 bridges over 18th Street S and 15th Street S. These crossings would be replaced by at-grade intersections. Portions of retaining walls within the vicinity of these bridges would also be removed under this concept. Additional analysis would be required for removing the abutments, retaining walls, and fill adjacent to the existing buildings along Route 1, including geotechnical studies prior to detailed design.

At the Route 1 bridge approach over 18th Street, retained fill is in place against the first-floor walls at the Marriott Crystal Gateway Hotel, the Westin Hotel, and 1800 S Bell Street, and an investigation will need to be performed and a detailed design completed to avoid undermining

the building foundations. Any demolition or excavation activities at these locations must be undertaken with care to avoid undermining foundation soils for the building foundations and causing a loss of bearing capacity or lateral stability or causing any other damage to these buildings. The emergency exit stairwells for the Marriott Crystal Gateway Hotel would need to be reconfigured to match the new sidewalk elevations. Additional retaining walls in front of the buildings or architectural façade work may also be required unless those land parcels are redeveloped in concert with a reconstructed Route 1 and its new wide sidewalks within new pedestrian zones.

The at-grade concepts also would involve the removal of existing soils and pavement in the study area. The roadway would be lowered by approximately 20 feet in certain areas of the corridor. On-site disposal of excess soils does not appear to be practical within the corridor, so an alternative disposal site would need to be identified and permitted for excess material. Care would need to be exercised to monitor and mitigate vibrations and control groundwater during construction.



*Retaining Wall and Former S. Clark Street Bridge Abutment Along 18th Street S*

New pavement for Route 1 would be constructed as part of the at-grade concept. The new pavement would need to be designed for the anticipated traffic loads and patterns. The existing pavements for 20th Street S, 18th Street S, and 15th Street S would ideally be overlaid and retained to the maximum extent practicable, with pavement replacement and widening where needed.

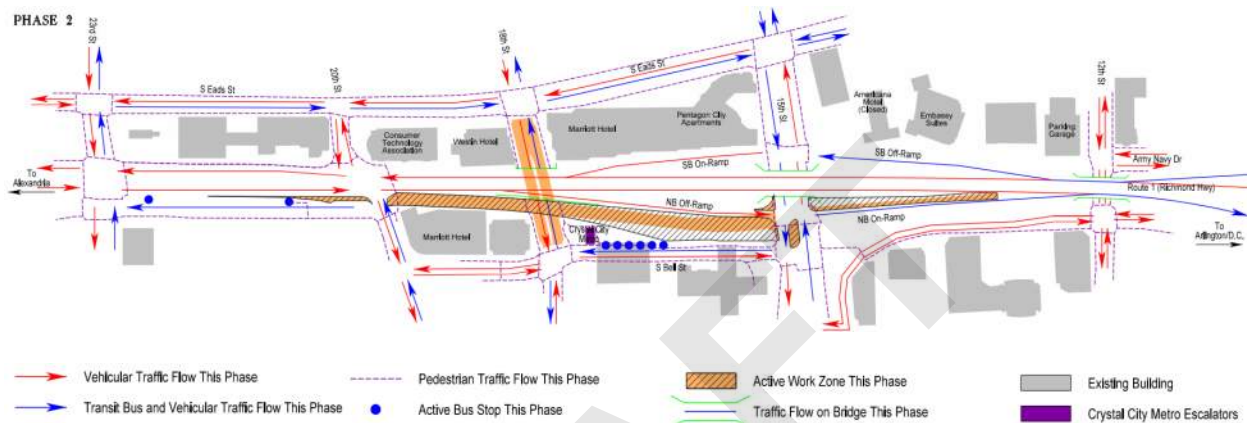
### **Anticipated Sequence of Construction**

The at-grade concepts appear to be constructable while able to maintain pedestrian, bicycle, transit and vehicular travel patterns using a construction approach that would involve six major phases of construction. Some sub-phases of work are would also be likely within the major construction phases. A detailed discussion of each potential construction phase can be found in Appendix B-1. A representative diagram of one of the six construction phases is shown in **Figure 7-1**.

Safely maintaining existing travel patterns during construction is critical to the success of the project. Proposed construction phases were developed in a manner that preserves as much of the existing multimodal travel network as practicable during construction. Where vehicular movements and sidewalks need to be closed or relocated during construction for the safety of the workers and the general public, the construction approach would minimize the duration of the closure and the overall impact of the closure on the transportation network in the Crystal City area. Minor disruptions (such as a sidewalk detour to the opposite side of the street,

closure of a turn lane, temporary bus stop relocation, street detour for a short period of time, etc.) would likely need to occur within each phase of construction.

The only anticipated major long-term detour would be the existing sidewalk along the west side of Route 1 between 20th Street S and 15th Street S (adjacent to Pentagon City Apartments, Marriott Crystal Gateway Hotel, Westin Hotel, and Consumer Technology Association), which would be closed to pedestrians for the duration of construction. The existing sidewalk network along S Eads Street and S Bell Street provides an adequate (and calmer) alternative to Route 1 for pedestrians during construction.



**Figure 7-1 Representative Construction Phasing Diagram (At-Grade Configuration)**

### 7.1.2. Grade-Separated Configuration

The following section provides an assessment of constructability for a Grade-Separated concept based on the Sector Plan, which would still involve reconstruction of Route 1 bridges at 15th Street S and 18th Street S. It discusses impacts to structures and soils and provides an anticipated sequence of construction.

#### **Impacts to Bridges, Retaining Walls, and Soils**

The Sector Plan concept would involve the replacement of the existing Route 1 bridges over 18th Street S and 15th Street S. These existing two-span crossings would ideally be replaced with single-span bridges. Portions of retaining walls and abutments within the vicinity of these bridges also would be removed under this concept, although additional study is needed to determine if certain portions can remain. (See detailed discussed in Appendix B-1.)

Additional analysis during design of Route 1 multimodal improvement will be required for removing the abutments, retaining walls, and fill adjacent to the existing buildings along Route 1. Retained fill is in place against the first-floor walls at the Marriott Crystal Gateway Hotel, the Westin Hotel, and 1800 S Bell Street and an investigation will need to be performed to avoid overloading the building foundations with placement of additional fill. Any demolition or excavation activities at these locations must be undertaken with care to avoid impact to the building foundations and causing a loss of bearing capacity or lateral stability or causing any other damage to these buildings. The emergency exit stairwells for the Marriott Crystal Gateway

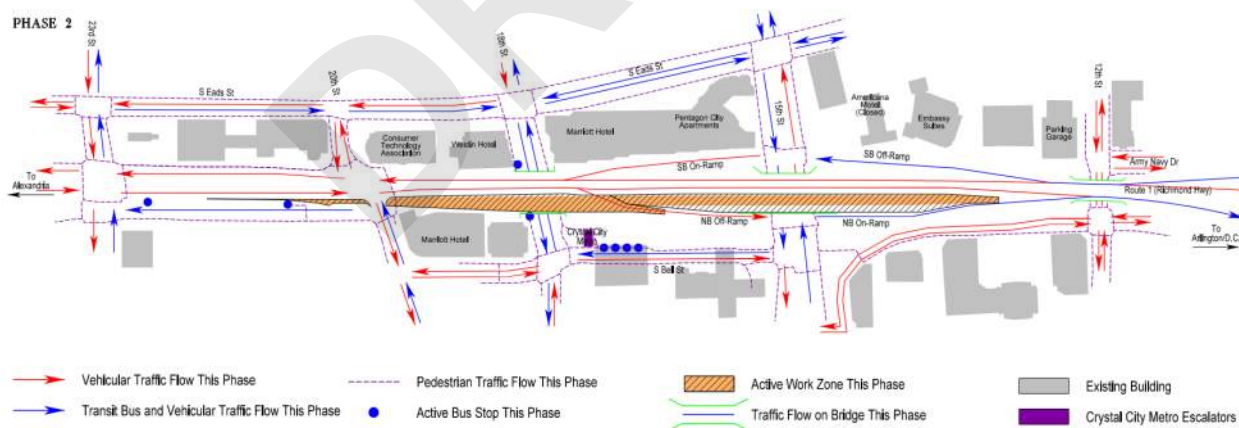
Hotel would need to be reconfigured to match the new sidewalk elevations. Existing building exits may need to be reconfigured to match the proposed concept. Additional retaining walls in front of the buildings or architectural façade work may also be required.

The Sector Plan concept also involves the removal of existing soils and pavement in the project area. The roadway would need to be raised by approximately 5 to 25 feet in certain areas of the corridor, with the new retaining walls needed near 15th Street S to support the new interchange configuration. Import of borrow material may be necessary due to the anticipated construction phasing. On-site disposal of excess soils does not appear to be practical within the project area, so an alternative disposal site needs to be identified and permitted for excess material.

New pavement for Route 1 would be constructed as part of the Sector Plan concept. The new pavement would need to be designed for the anticipated traffic loads and patterns. The existing pavements for 20th Street S, 18th Street S, and 15th Street S would ideally be overlaid and retained to the maximum extent practicable, with replacements and pavement widening where needed.

### **Anticipated Sequence of Construction: Grade-Separated Sector Plan Concept**

The Sector Plan concept appears to be constructable while maintaining vehicular, pedestrian, bicycle, and transit traffic patterns using a construction approach that would involve six major phases of construction. Some sub-phases of work would also be likely within the major construction phases. A detailed discussion of each potential construction phase can be found in Appendix B-1. A representative diagram of one of the six construction phases is shown in **Figure 7-2**.



**Figure 7-2 Representative Construction Phasing Diagram (Grade-Separated Configuration)**

## 7.2. Stormwater Management Considerations

As a part of the Route 1 feasibility study, the study team also reviewed potential stormwater management and best management practices (BMP) regulations and requirements necessary for future implementation of the concepts developed. The preliminary analysis reviewed the 10-year design storm for the corridor delineated based on VDOT survey and Arlington County GIS topography data. The survey and GIS data were supplemented by site visits and site review to identify potential offsite outfalls which were not included in the survey for analysis.

The at-grade concept design scenarios (Options 1, 2, and 3) and the grade-separated Sector Plan concept were found to reduce the overall flow as compared to existing conditions due to the significant reduction in impervious area from both concepts. Due to the reduction in impervious area from existing conditions, neither scenario is anticipated to require major BMP facilities. Constructing BMPs in such an urban corridor would be a challenge, though none appear to be necessary per the preliminary stormwater management analysis. The water quality and quantity needs can be met through the mix of reducing impervious area for water quantity and purchasing nutrient credits to meet the water quality requirements. Using the Virginia Runoff Reduction Method (VRRM) spreadsheet developed by the Virginia Department of Environmental Quality (DEQ) the estimated nutrient credit need for the at-grade concepts is 1.23 lbs/year versus the Sector Plan concept, which would need approximately 3.59 lbs/year. The cost per pound of nutrient credits is approximately \$20,000, which provides significant savings in comparison to constructing and maintaining BMP facilities along the corridor. This conclusion is based on changes to impervious/pervious area; further detailed hydraulic analysis would be required to verify the adequacy of outfalls along the Route 1 corridor.

## 7.3. Analysis of Developable Land

One of the goals associated with the Route 1 corridor improvements was to identify existing VDOT right-of-way and street easements which currently serve the Route 1 corridor and find ways to consolidate them such that additional land could be developed to build out Crystal City and National Landing. As a part of the design of both the at-grade and grade-separated concepts, the scenarios tighten the width of the corridor using urban design standards and narrower lanes to create additional developable land on both sides of the corridor. As shown in **Figure 7-3** and **Figure 7-4** below, the at-grade conceptual design identified approximately 6-1/2 acres of excess right-of-way and easements which could be reallocated for future development. The grade-separated concept identified approximately 5 acres of excess right-of-way and easements which could be reallocated for future development.



**Figure 7-3 Analysis of Potential Excess Right-of-Way (At-Grade Configuration)**



**Figure 7-4 Analysis of Potential Excess Right-of-Way (Grade-Separated Configuration)**

The at-grade concepts (Options 1, 2, and 3) provide approximately 1-1/2 acres more developable land than the grade-separated concept. This additional potential excess right-of-way is due to the additional curvature of the Route 1 alignment and the removal of the ramps and infrastructure associated with the interchange at 15th Street S. This additional potential excess right-of-way provides more acreage for development adjacent to a future multimodal urban boulevard.

#### 7.4. Planning-Level Conceptual Cost Estimates

To further evaluate the feasibility of the preliminary Route 1 corridor concepts, this study analyzed the potential project costs for both the at-grade and grade-separated configurations. The refined concept plans were used to provide VDOT with planning-level conceptual cost estimates. The cost estimation methodology for each configuration used VDOT's SYIP Projects Detailed Project Cost Estimate Summary Tool (Version: April 2021) and VDOT 2-year district average data, along with VDOT's internal cost estimation methods. This tool is a commonly used cost estimating tool used by VDOT and by local agencies to develop a preliminary project cost estimates to support funding applications and to manage capital improvement programs. The cost estimating tool considers a wide range of inputs that are used to calculate estimated costs to develop a total project estimate, which consists of four main categories: preliminary engineering estimate (PE), construction (CN), right-of-way (RW), and utilities (UT). The following construction costs were considered as part of each concept:

- Bridges
- Culverts/Large Drainage Structures
- Large Retaining Walls
- Lighting
- Earthwork considerations
- Bicycle and Pedestrian Facilities
- Environmental considerations
- Roadway construction

The information gathered from the site visits, GIS data, VDOT survey, and the refined conceptual design plans were used to identify appropriate inputs for the tool. Given the limited level of field investigations and the limited detail in the conceptual design plans, the data inputs in the tool are based on conservative estimates of quantities and unit prices.

The conceptual costs estimates were developed initially without any contingencies or inflation and assumed 2021 costs. As the estimates were finalized, contingencies and escalation factors were applied. The results of this estimating exercise are shown in **Table 7-1** and **Table 7-2**. Refer to **Appendix H, Conceptual Cost Estimates** for more detail on the conceptual cost estimates conducted for this feasibility study.

The cost estimates summarized in the tables below and shown in detail in Appendix H were informed by the refined concept plans for the at-grade Option 1 and by the grade-separated Sector Plan concept. For the lower-cost option of improving the existing Route 1 highway configuration, as discussed in Section 6.5.5 of this report, VDOT assigned a cost range of \$5M to \$15M for such a project.

**Table 7-1 Conceptual Cost Estimate for At-Grade Concept 1**

Phase	Total (\$millions)
PE	\$ 16.0
RW	3.0
CN (with UT)	158.3
<b>Total Estimate</b>	<b>\$ 177.3</b>

Phase	At-Grade Configuration (\$millions)	Grade-Separated Sector Plan Configuration (\$millions)
Preliminary Engineering (Design, Environmental, Permitting)	\$ 16.0	\$23.6
Right-of-Way	3.0	1.7
Construction (including utilities)	158.3	233.2
<b>Total Estimate</b>	<b>\$ 177.3</b>	<b>\$258.5</b>

**Table 7-2 Conceptual Cost Estimate for Grade-Separated Sector Plan Concept**

Phase	Total (\$millions)
PE	\$ 23.6
RW	1.7
CN (with UT)	233.2
<b>Total Estimate</b>	<b>\$ 258.5</b>

## 7.5. At-Grade Multimodal Transportation and Safety Evaluation

From a feasibility perspective, an at-grade Route 1 is anticipated to result in changes to travel patterns, traffic operations, and safety across all modes in the study area. This section of the report summarizes the findings from a multimodal transportation and safety evaluation conducted as part of this study effort. In general, the findings suggest that operational and safety challenges would be manifested from an at-grade Route 1 if traffic volumes remain consistent with 2019 (pre-pandemic) volumes or if these volumes increase in the future, which is how future-year traffic operations are typically analyzed. However, this type of analysis likely represents a conservative “worst case” analysis that does not account for considerations such as significant planned investments in transit services parallel to Route 1. Most notably, empirical evidence exists from a limited number of freeway-to-at-grade conversion projects around the US that traffic volumes *decrease* given the reduction in capacity, and trips are absorbed into the regional and local street network and by other modes such as rail and bus transit.

Please refer to **Appendix I, Build Conditions Transportation Operations Summary** for a detailed summary and comparison of all transportation and safety-related analyses conducted for the at-grade concepts. Note that this section does not explicitly discuss traffic operations for the grade-separated concept, although it can be assumed from a feasibility perspective to operate similarly to the future No-Build conditions described in Chapter 4, in which the 15th Street S crossing remains an interchange and the 18th Street S crossing remains separated with no interaction with Route 1.

### 7.5.1. Multimodal Traffic Operations – Arlington County Forecasts

The following sections summarize results comparing the three At-Grade Build options versus a corresponding Existing or No-Build option using the traffic forecasts provided by Arlington County. This analysis is intended to provide a conservative assessment of the impacts of an at-grade Route 1. The following MOEs were considered:

- **Multimodal Travel Time for Crossing Route 1:** Travel times along both 15th Street S and 18th Street S between S Eads Street and S Bell Street have been measured for pedestrians, bicycles, and vehicles (autos and buses) using outputs from the Vissim models. These measurements allow for a comparison across scenarios for how each mode’s travel time is affected crossing Route 1.
- **Bus Travel Times:** Bus travel times through the study area were measured for key high-frequency bus routes (ART 43 and Metroway northbound/southbound) as well as local and commuter bus routes across all scenarios.
- **Vehicular Travel Times and Network Travel Speeds:** Vehicular travel times along Route 1 northbound and southbound through the study area were measured along with travel times along parallel north-south side streets and east-west cross streets. In addition, speed heat maps were produced for all scenarios which can provide insight into network hot spots for congestion or delay.
- **Intersection Performance (Delay and LOS):** Intersection delay and LOS were quantified for all study area intersections across all scenarios, providing insight into hot spots for congestion or delay for specific turning movements. While intersection delay

and LOS are reported for vehicular traffic in general, these operations affect the movements of transit buses through the study area as well.

Multimodal traffic operations MOEs are summarized in detail in Appendix I, which includes figures and tables for the MOEs listed above for the AM and PM peak hours for Existing (2019), 2025, and 2040 conditions. *For the summary in the following section, example figures have been provided for either 2025 AM or PM conditions as points of reference.*

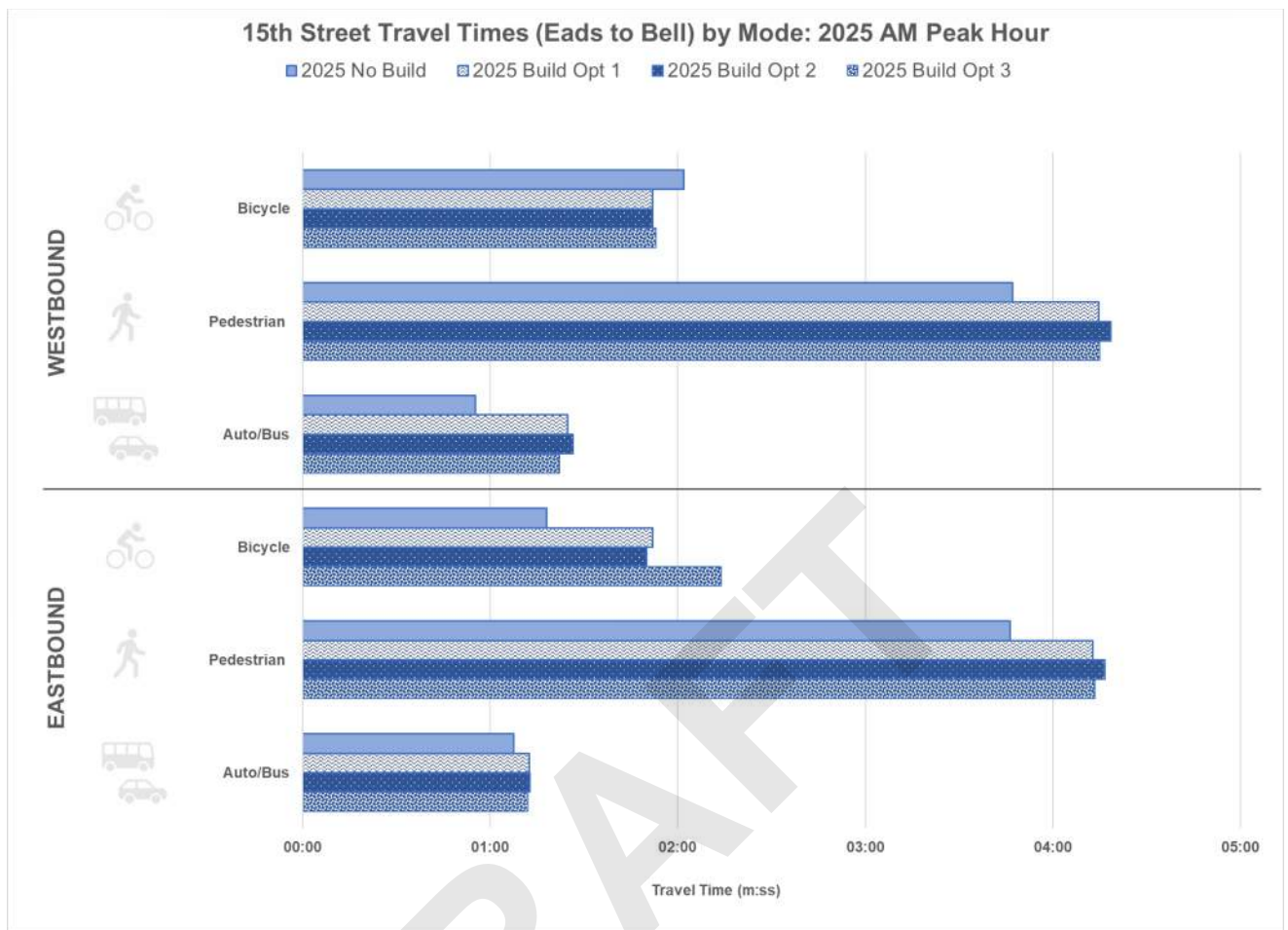
### **Multimodal Travel Time for Crossing Route 1**

#### **15th Street S**

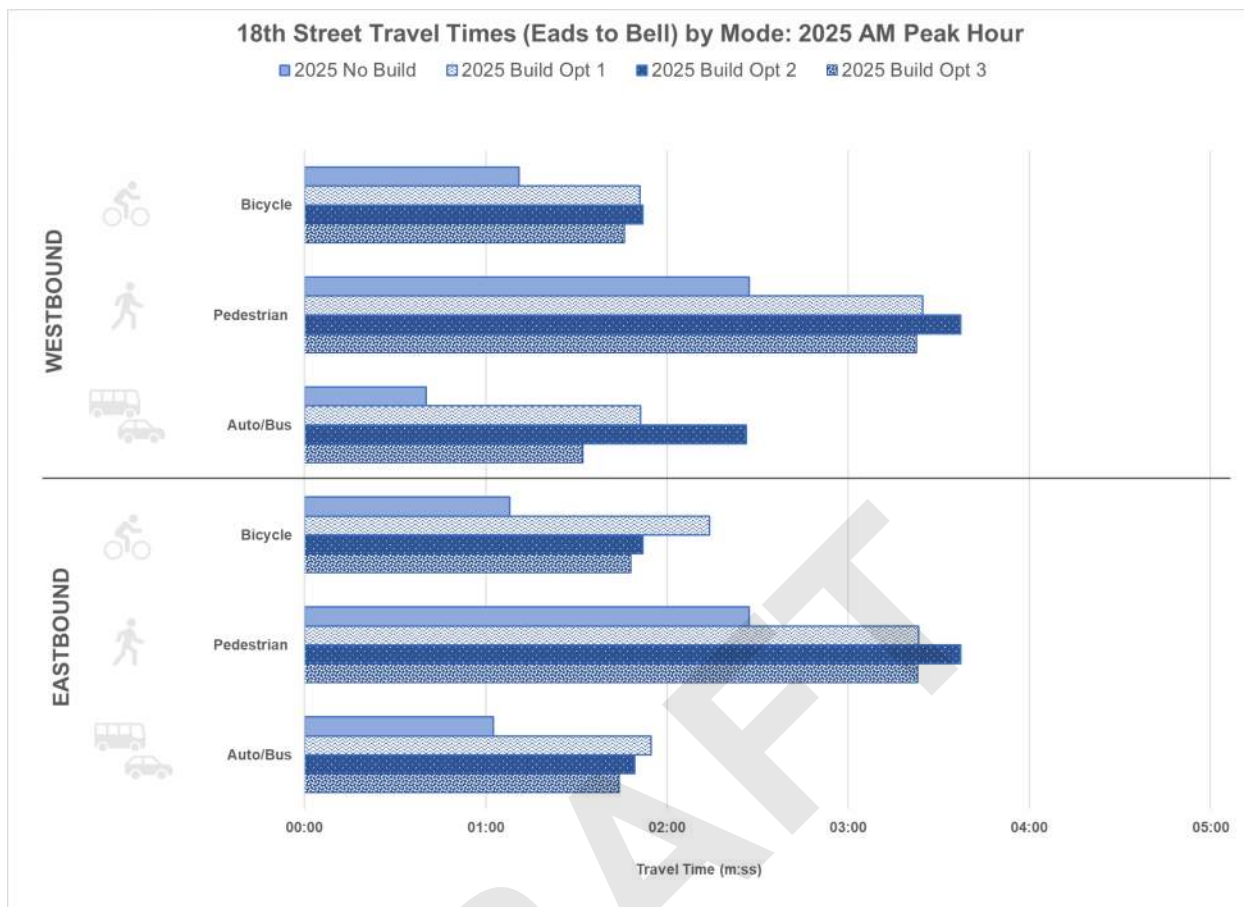
- Average bicycle and pedestrian travel times generally show minor increases in the At-Grade Build options due to the conversion of the two interchange signals to a single signalized intersection. Some exceptions to this trend are observed, most notably during the PM peak in future years, as the Build options provide a new dedicated bike lane in the westbound direction, rather than forcing cyclists to ride in mixed traffic.
- Average auto and bus travel times generally increase in the At-Grade Build options, most notably in the eastbound direction during the AM peak due to queue spillback from eastbound left turns onto northbound Route 1.
- As an example, **Figure 7-5** provides a comparison figure for multimodal crossing times at 15th Street S, showing travel times for the various Build concepts using 2025 AM peak hour volumes.

#### **18th Street S**

- Average bicycle and pedestrian travel times increase in the At-Grade Build options due to the new signalized intersection with Route 1, though generally only by 30 to 60 seconds on average.
- Average auto and bus travel times generally increase in the At-Grade Build options, in some cases by several minutes. The increases in travel time are generally greatest in the eastbound direction (into Crystal City) during the AM peak and in the westbound direction (out of Crystal City) in the PM peak. Increased congestion in the westbound direction impacts the operations of several bus routes, including routes using southbound S Bell Street for access to the Metrorail station.
- As an example, **Figure 7-6** provides a comparison figure for multimodal crossing times at 18th Street S, showing travel times for the various Build concepts using 2025 AM peak hour volumes.



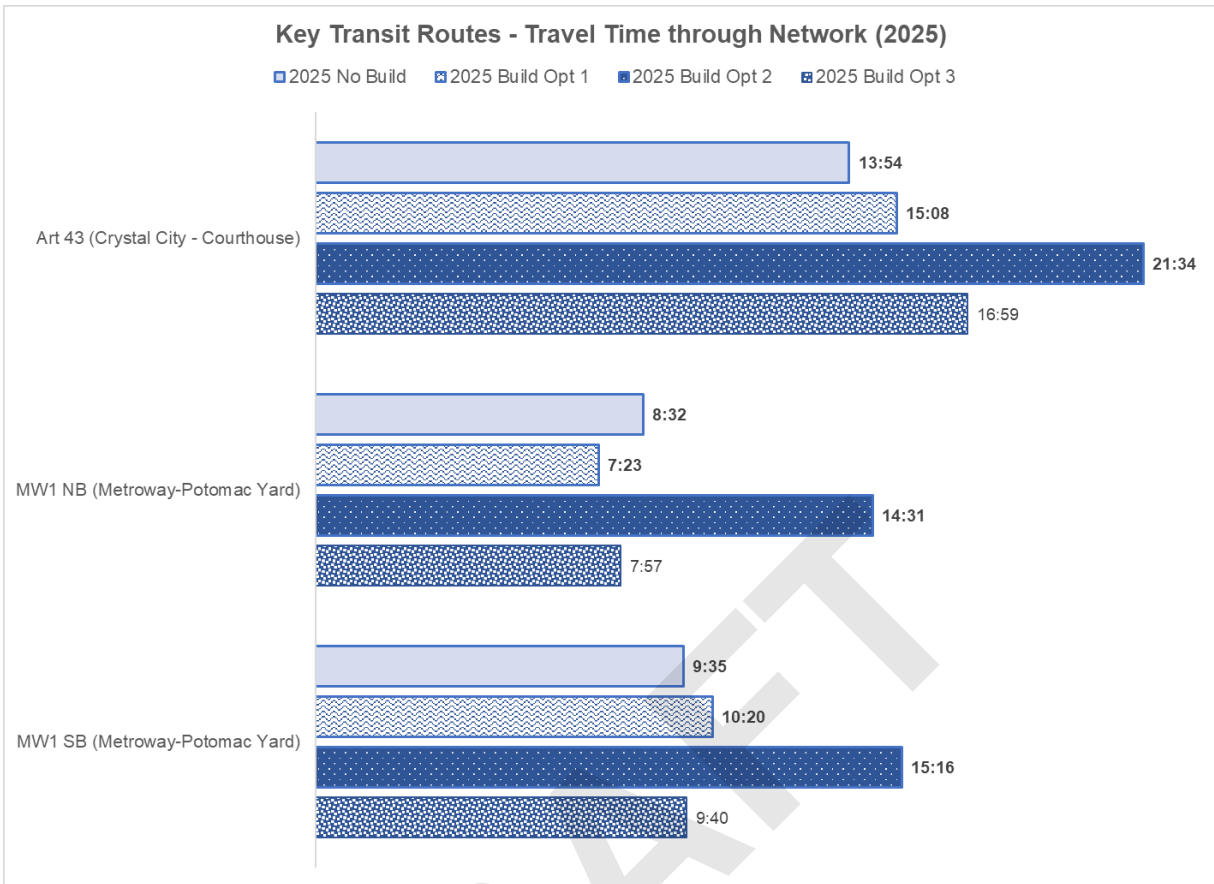
**Figure 7-5 Example 15th Street Multimodal Travel Times Crossing Route 1 – With 2025 AM Peak Hour Volumes**



**Figure 7-6 Example 18th Street Multimodal Travel Times Crossing Route 1 – With 2025 AM Peak Hour Volumes**

## Bus Travel Times

- Along the **ART 43 route**, which travels south along Route 1, turns left onto eastbound 15th Street S, and then turns south along S Bell Street, average travel times increase in all At-Grade Build options in all analysis years due to increases in the time to get from southbound Route 1 to eastbound 15th Street S (southbound left turn). Additionally, this route experiences delays along southbound S Bell Street near the Metro station due to queue spillback from congestion along westbound 18th Street S; this delay is most prominent in Option 2.
- Along the **northbound Metroway BRT route**, which travels along northbound Crystal Drive and westbound 12th Street S, average travel times increase slightly in all analysis years. The most significant increase in travel time is in Option 2, which sees the highest additional circulating traffic volume on side streets.
- Along the **southbound Metroway BRT route**, average travel times increase slightly in Options 1 and 3 as compared to No-Build conditions but increase much more substantially in Option 2, due to increased circulating traffic volume and congestion along westbound 18th Street S and southbound S Bell Street.
- Significant increases in travel time are observed in all three At-Grade Build options for **several commuter bus routes that would no longer use the existing bus stops along 18th Street S**: Loudoun County Route 882, Fairfax Connector Route 599, and OmniRide Route L-200. For this analysis, these routes were assumed to use the proposed bus transfer facility north of 18th Street S between Route 1 and S Bell Street, which is noted in the Sector Plan and discussed in Chapter 6 of this report. To access this facility, buses would need to divert to a longer path through the study area—eastbound 15th Street S to southbound S Bell Street to westbound 18th Street S before accessing the proposed bus transfer facility heading northbound, forming a clockwise loop before exiting back out to southbound S Bell Street. The clockwise loop involving southbound S Bell Street significantly increases travel times for these routes.
- As an example, **Figure 7-7** provides a comparison figure for bus travel times, showing travel times along the ART 43 and Metroway routes for the various Build concepts using 2025 PM peak hour volumes.



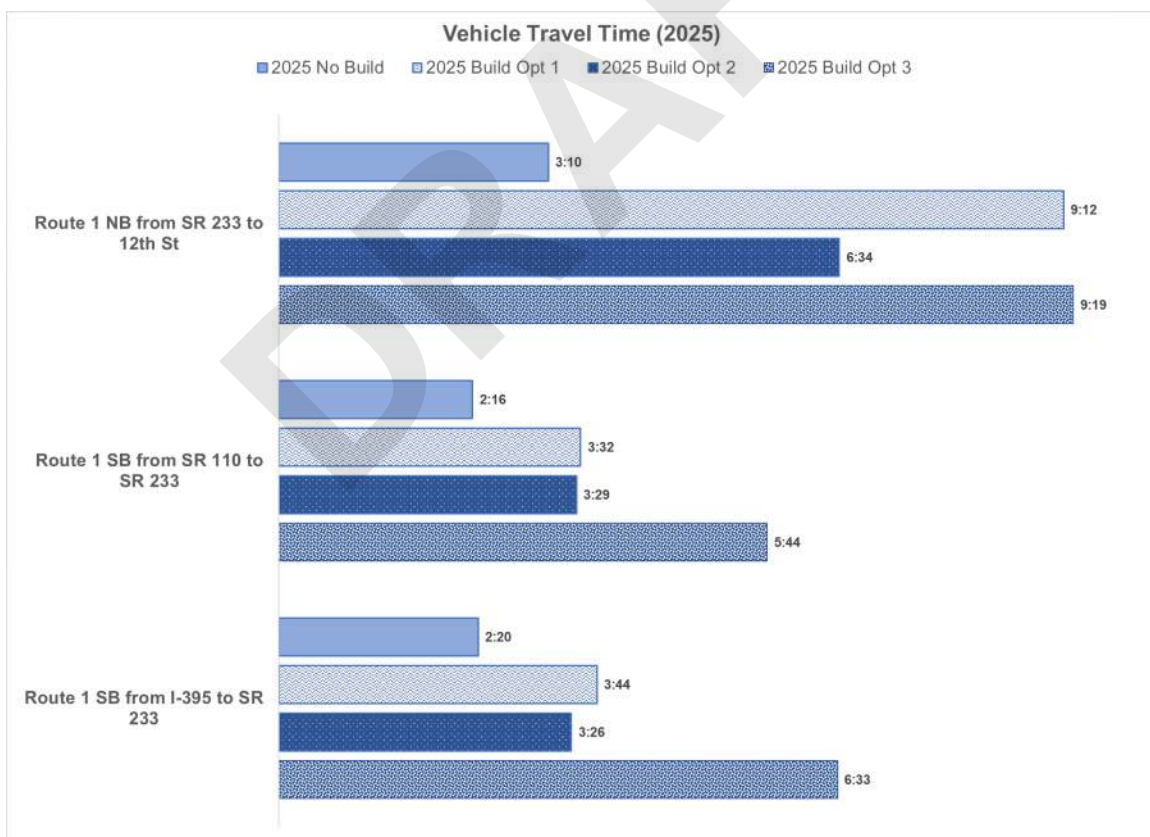
**Figure 7-7 Example Bus Travel Times – Key Transit Routes with 2025 PM Peak Hour Volumes**

### **Vehicular Travel Times and Network Speeds**

- Along northbound Route 1, travel times typically increase the most for At-Grade Build Options 1 and 3 as compared to No-Build. Option 2, which eliminates left turns off of Route 1 and is thus able to provide more green time for Route 1 through trips, generally results in a much smaller increase in travel time.
- Along southbound Route 1, At-Grade Build Options 1 and 2 generally show comparable increases in travel time. Option 3, however, shows a more significant increase in travel time due to increased queueing on the southbound approach to the signal at 15th Street S, as all left turns onto and off of Route 1 must use this intersection (no left turns are allowed in either direction at 18th Street S in this option). In general, Option 3 shows the lowest speeds along Route 1 in both directions approaching the 15th Street S intersection. In the PM peak, especially in future analysis years, queue spillback along southbound Route 1 extends beyond the SR 110/I-395 ramp gore and onto the ramp from I-395. This queueing is generally the worst in Option 3 and the least impactful in Option 2.
- In all three At-Grade Build options, slow speeds are shown along eastbound 15th Street S approaching Route 1, especially during the AM peak, due to queue spillback from the intersection with Route 1. Speeds along 15th Street S are typically slightly higher in

Option 2 due to the removal of the conflicting left-turn phases from Route 1; in Options 1 and 3, low speeds and queueing are observed spilling back to S Fern Street.

- All three At-Grade Build options show increases in travel time along northbound and southbound S Eads Street, especially during the AM peak, again due to queue spillback along 15th Street S stemming from the proposed intersection at Route 1.
- In all three At-Grade Build options, slow speeds are shown along eastbound 18th Street S approaching Route 1 due to queue spillback from Route 1. Speeds along 18th Street S are highest in Option 3 due to the removal of all left turn phases at the intersection with Route 1.
- Along the side street network, Option 2 shows slow speeds along 12th Street S due to the additional circulating volume through the neighborhood street network. Option 2 also shows low speeds along southbound S Bell Street approaching 18th Street S, again due to the additional circulating volume through the neighborhood street network.
- As examples, **Figure 7-8** provides a comparison figure for vehicular travel times, showing travel times along northbound and southbound Route 1 for the various Build concepts using 2025 AM peak hour volumes, while **Figure 7-9** provides a comparison figure for vehicular travel speeds for the same 2025 AM peak hour timeframe.



**Figure 7-8 Example Vehicle Travel Times – Route 1 Corridor with 2025 AM Peak Hour Volumes**

## 2025 AM Peak Hour Average Speed Comparison

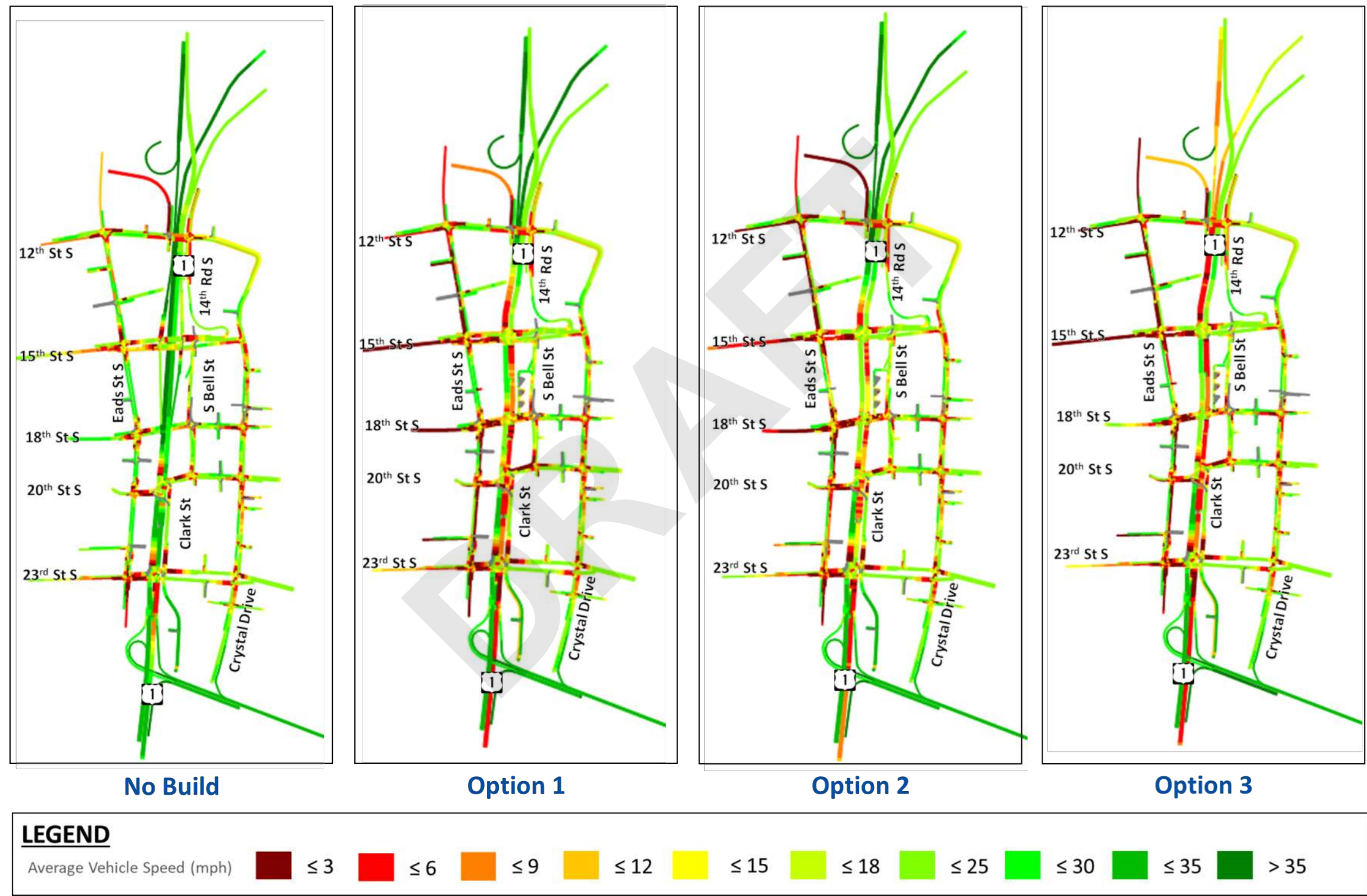


Figure 7-9 Example Average Speed Comparison – With 2025 AM Peak Hour Traffic Volumes

### Intersection Performance (Delay and LOS)

This section summarizes observed operational issues at intersections throughout the study area. As an example, **Table 7-3** provides a comparison of intersection delay and LOS across the various Build concepts using 2025 AM peak hour volumes.

**Table 7-3 Example Comparison of Intersection Delay and LOS/  
– With 2025 AM Peak Hour Volumes**

	#	Intersection	2025 No-Build	2025 Option 1	2025 Option 2	2025 Option 3
15TH STREET	204	15th Street and Eads Street (Signalized)	D (45.8)	F (167.8)	F (114.4)	F (256.5)
	1001	15th Street and Route 1 At-Grade (Signalized)		E (68.2)	D (40.3)	F (144.6)
	101	15th Street and Route 1 Southbound Ramp (Signalized)	C (23.4)			
	102	15th Street and Route 1 Northbound Ramp (Signalized)	A (7.2)			
	205	15th Street and Bell Street (Unsignalized)	A (4.6)	A (1.9)	A (2.2)	A (1.5)
	206	15th Street and 14 Rd S (Clark Street) (Unsignalized)	A (8.6)	A (2.4)	A (3.3)	A (3.5)
	207	15th Street and Crystal Dr (Signalized)	B (19.1)	B (17.7)	B (19.5)	B (17.4)
18TH STREET	208	18th Street and Eads Street (Signalized)	C (21.0)	F (185.0)	F (121.3)	E (78.8)
	1002	18th Street and Route 1 At-Grade (Signalized)		D (46.2)	C (27.1)	D (39.8)
	209	18th Street and Bell Street (Signalized)	B (16.9)	B (17.2)	B (18.7)	B (15.2)
	210	18th Street and Crystal Dr (Signalized)	B (17.2)	C (26.6)	C (25.3)	C (26.1)
20TH STREET	211	20th Street and Eads Street (Signalized)	B (12.5)	F (132.6)	D (53.9)	E (74.6)
	103N	20th Street and Route 1/Clark Street (Signalized) (Northern Portion)	B (13.6)	C (20.0)	B (14.7)	C (22.0)
	103S	20th Street and Route 1/Clark Street (Signalized) (Southern Portion)	A (7.0)	D (45.0)	C (28.1)	D (49.0)
	212	20th Street and Bell Street (Unsignalized)	A (8.9)	E (61.6)	A (8.7)	B (18.3)
	213	20th Street and Crystal Dr (Signalized)	B (14.2)	B (12.9)	B (14.2)	B (12.9)
12TH STREET	201	12th Street and Eads Street (Signalized)	D (39.0)	E (73.1)	F (87.8)	F (169.7)
	202	12th Street and Army Navy Dr (Unsignalized)   2025 - Intersection becomes signalized	F (98.6)	F (99.3)	F (113.7)	F (88.5)
	203	12th Street and Long Bridge Dr / Clark Street (Signalized)	D (47.1)	D (46.7)	D (45.6)	D (46.9)
23RD STREET	104E	23rd Street and Route 1/Clark Street (Signalized) (Eastern Portion)	C (22.7)	C (21.5)	C (21.6)	C (24.0)
	104W	23rd Street and Route 1/Clark Street (Signalized) (Western Portion)	D (53.4)	F (137.7)	F (106.7)	F (137.8)
	214	23rd Street and Eads Street (Signalized)	F (81.4)	F (123.4)	F (84.4)	F (97.1)
	215	23rd Street and Crystal Drive (Signalized)	B (19.0)	C (20.8)	C (21.7)	C (20.9)

### 15th Street S Area

- Route 1 and 15th Street S:** Each At-Grade Build option demonstrates worse intersection performance than the No-Build condition (i.e., Route 1 not at-grade), as expected. The greatest contribution of delay for each Build option is left-turning traffic, most notably the eastbound left turns during the AM peak. Option 2 demonstrates less delay than Options 1 and 3 because left turns from Route 1 are prohibited at the intersection.

- **S Eads Street and 15th Street S:** In each At-Grade Build option, performance worsens at 15<sup>th</sup> Street S and S Eads Street as a result of spillback from eastbound left-turn queueing at Route 1 and 15th Street S.

#### 18th Street S Area

- **Route 1 and 18th Street S:** This proposed at-grade intersection operates at LOS E or better for all At-Grade Build options in all analysis years. Option 2 performs better than Options 1 and 3 because left turns from Route 1 at the intersection are prohibited, which reduces delay on Route 1 (except in 2040 AM, where Option 2 experiences gridlock). While Option 3 does prohibit all left turns at 18th Street S, congestion on Route 1 northbound due to queue spillback from 15th Street S results in high delay for the northbound approach and side-street turning vehicles.
- **S Eads Street and 18th Street S:** In each At-Grade Build option, performance worsens at S Eads Street and 18th Street S as a result of spillback from eastbound left-turn queueing at Route 1 and 18th Street S. The deterioration in operations at this location is most pronounced during the AM peak and is worse in Options 1 and 2 than in Option 3.
- **S Bell Street and 18th Street S:** In the PM peak, performance worsens at S Bell Street and 18th Street S relative to the No-Build condition in each At-Grade Build option due to the close spacing with the new Route 1 and 18th Street S signal. Queues from the westbound approach to this intersection spill back to S Bell Street, resulting in increased delay for vehicles and notably for several bus routes which utilize S Bell Street to access the Metro station. Performance at this location is worst in Option 2.

#### Intersections North of 15th Street S (12th Street S Area)

- In the AM peak, the intersection at **12th Street S and S Eads Street** worsens in all At-Grade Build options as a result of queueing that spills back from the eastbound approach of **Route 1 and 15th Street S**.
- In the PM Peak, intersection performance along 12th Street S generally remains consistent with the No-Build condition for Options 1 and 3. Option 2, however, demonstrates increases in delay at all intersections along the corridor due to increased vehicular demand circulating along 15th Street S, S Crystal Drive, 12th Street S, and S Eads Street to travel to their destinations.

#### Intersections South of 18th Street S (20th Street S and 23rd Street S Area)

- **Background Improvements:** By 2040, S Clark Street is aligned with S Bell Street at 20th Street S and 23rd Street S, which results in improved intersection spacing along both corridors and reduces the complexity of intersection movements immediately adjacent to Route 1.
- **20th Street S Corridor:** In general, the operations on the west side of Route 1 (the intersection of 20th Street S and S Eads Street) worsen in the At-Grade Build scenarios, most notably during the AM peak for scenarios in which queue spillback along S Eads Street (from 18th Street S or points north) affects this location. The operations on the

east side of Route 1 generally worsen during the PM peak, most notably when queue spillback along S Bell Street (from 18th Street S) affects this location.

- **23rd Street S Corridor:** The intersection of Route 1 and 23rd Street S (and with S Clark Street in the Existing and 2025 analysis years) generally shows a degradation in operations in the Build options. This is attributable to occasional queue spillback along northbound Route 1 from downstream intersections.

### **Summary of Primary At-Grade Operational Challenges**

Several recurring operational challenges were consistently observed across various analysis years and Build options, as shown in **Figure 7-10** and **Figure 7-11**.

- **Eastbound 15th Street S:** The proposed signalized intersection with Route 1 reduces the storage for eastbound left turns from 15th Street S, which is a heavy movement especially in the AM peak hour (approximately 650 vph in 2019 counts).
  - In addition to this reduction in queue storage, the eastbound left-turn green time is reduced as compared to a grade-separated interchange, as this movement cannot run at the same time as conflicting northbound/southbound Route 1 through traffic phases.
  - The combination of reduced storage and reduced green time increases delay and queueing for the eastbound left turns from 15th Street S, with queue spillback observed out of the network (to S Fern Street) during the AM peak hour in several Build option scenarios.
  - This queue spillback also affects operations along S Eads Street in both directions approaching 15th Street S.
  - In general, queueing on this approach is greatest in Option 3, as all left turns off of Route 1 must use the signal at 15th Street S, resulting in the shortest green times for eastbound left turns.
  - Queueing on this approach is generally the most reduced in Option 2, as not allowing left turns off of Route 1 allow for the longest green times for eastbound left turns. However, with increased traffic volumes, Option 2 results in gridlock along side streets due to increased circulating volume.
- **18th Street S (Both Directions):** The new signalized intersection with Route 1 would result in three traffic signals along 18th Street S in a less than 500-foot distance.
  - The signal in the middle (with Route 1) would have its green time constrained by the need to accommodate conflicting movements associated with Route 1, including northbound/southbound Route 1 through movements and (depending on the Build option) left turns onto and off of Route 1.
  - In addition, heavy pedestrian volumes are present in this area due to the Crystal City Metrorail station being immediately to the east of Route 1.

- The combination of closely spaced traffic signals and heavy pedestrian volumes affects vehicular throughput along eastbound/westbound 18th Street S, and queues are observed in various scenarios to spill back from Route 1 in both directions.
- To the west, queue spillback is possible beyond S Eads Street and onto S Eads Street, especially in the AM peak.
- To the east, queue spillback along westbound 18th Street S affects operations along southbound S Bell Street.
- Note that several bus routes (including the high-frequency Metroway and ART 43 routes) use southbound S Bell Street for transfers to Metrorail.
- The Vissim model results showed noticeable impacts to bus travel times in the various Build options, with bus operations generally being the worst in Option 2, as the additional circulating volume of traffic on side streets creates longer queues along westbound 18th Street S and southbound S Bell Street.
- **Southbound Route 1 North of 15th Street S:** Due to the new signalized intersection, southbound approach queueing along Route 1 is observed in the various Build options.
  - There would be approximately 1,100 feet of distance between the southbound approach stop bar at the signal and the ramp gore where the ramps from southbound SR 110 and southbound I-395 come together<sup>4</sup>.
  - Depending on the scenario and analysis year, queues are observed to spill back past this gore point, especially during the PM peak hour in which southbound traffic along Route 1 is heavier.
  - In general, queueing on this approach is greatest in Option 3, as all left turns off of Route 1 must use the signal at 15th Street S, resulting in the shortest green times for northbound/southbound Route 1 through phases.
  - Queueing on this approach is generally the most reduced in Option 2, as not allowing left turns off of Route 1 allow for the longest green times for northbound/southbound Route 1 through phases.

---

<sup>4</sup> Note that the ramp from southbound I-395 to southbound Route 1 contains approximately 2,000 feet of storage across two lanes, as in some scenarios, queues are observed to spill back along this ramp.

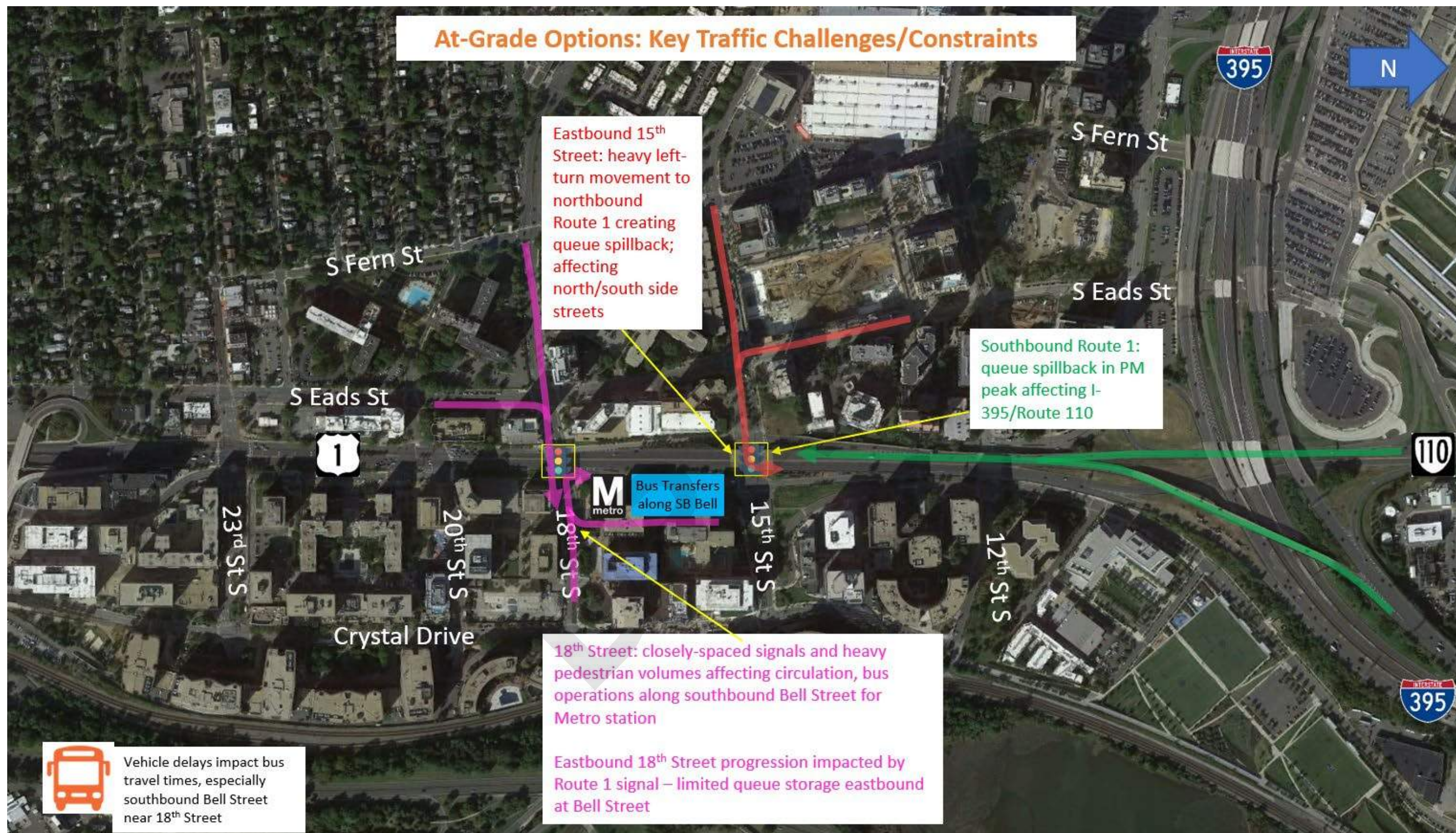
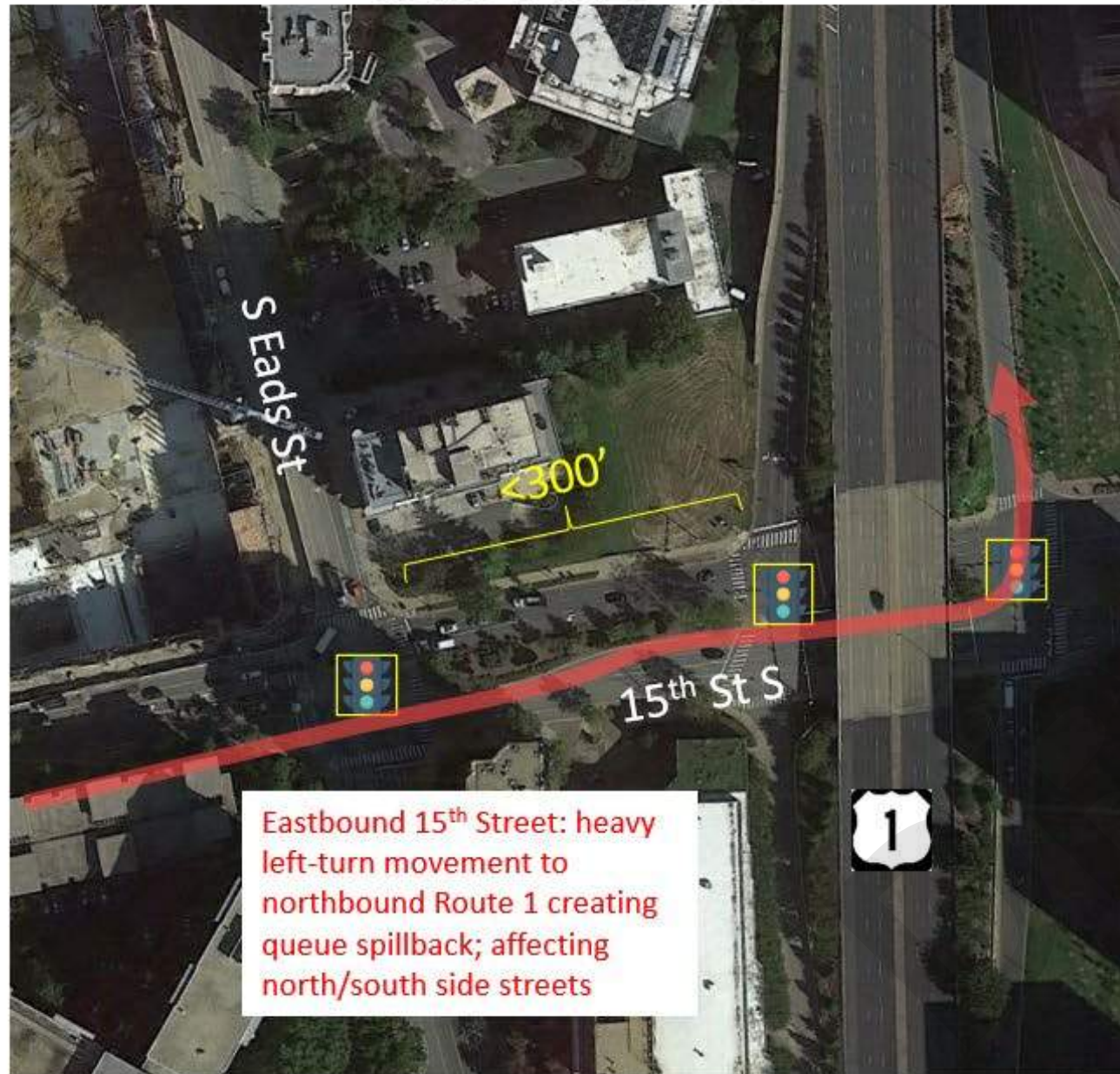


Figure 7-10 Key Traffic Challenges/Constraints for At-Grade Build Options

Route 1 at 15<sup>th</sup> St S



Route 1 at 18<sup>th</sup> St S

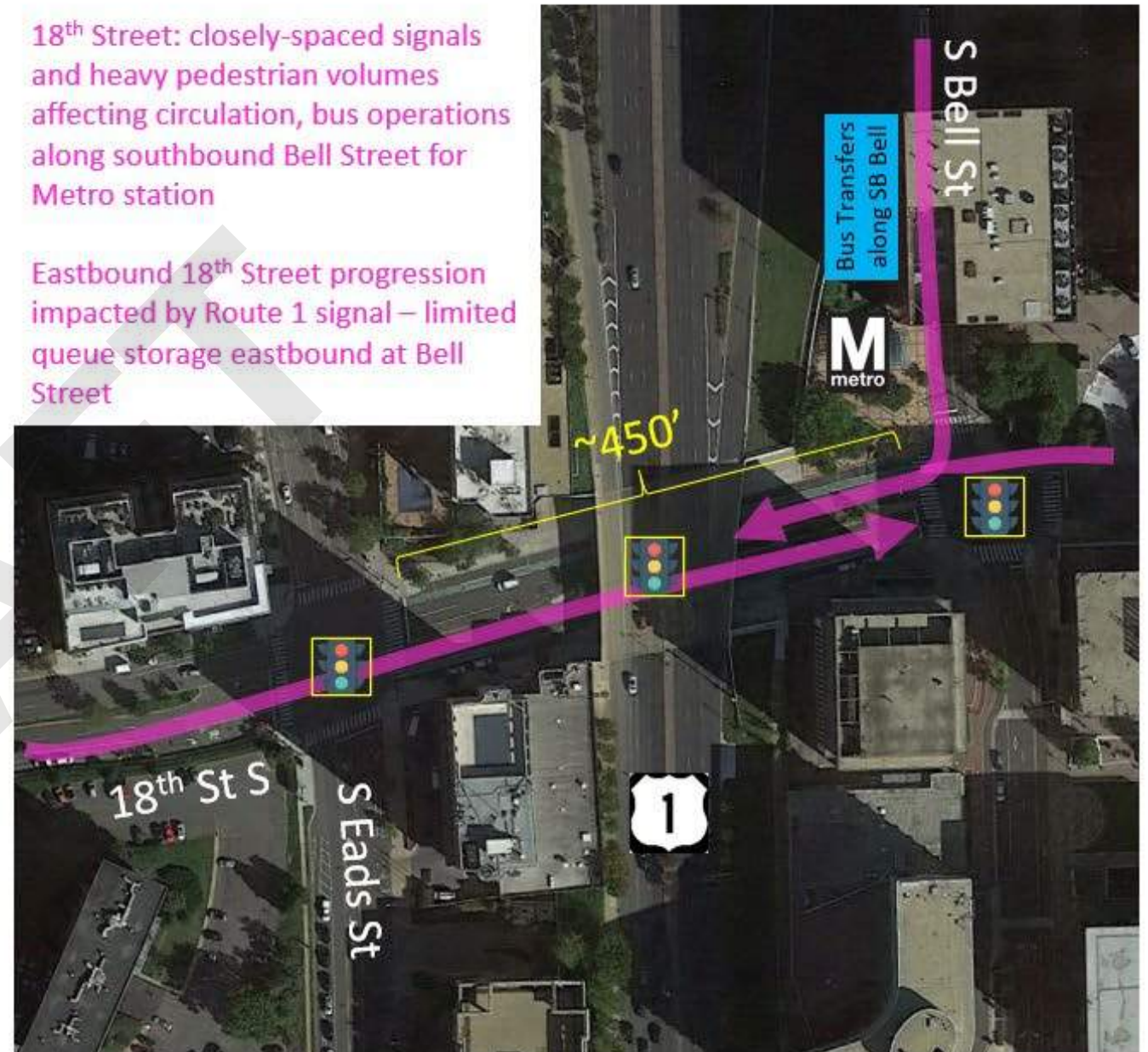


Figure 7-11 Key Traffic Challenges/Constraints for At-Grade Build Options (Zoom View)

### 7.5.2. Sensitivity Analysis – Travel Patterns and Mode Shift Considerations

The previous section showed traffic results for both No-Build and At-Grade Build options using the traffic forecasts provided by Arlington County for years 2025 and 2040, which show continued growth in traffic volume along Route 1 and in the study area. These traffic forecasts and results provide a conservative assessment of the traffic operations impact of an at-grade Route 1 but note several operational challenges with the Build options, especially in future-year scenarios.

This section describes a sensitivity analysis looking at traffic forecasts that *decrease* as compared to existing (2019) conditions, given the following considerations:

- Traffic volumes along Route 1 and in the National Landing area have stayed relatively consistent or even decreased in some locations during the past 15 years
- Both Arlington County and the Commonwealth of Virginia have committed to a large number of background multimodal transportation network improvements in the study area
- Arlington County continues to implement a nation-leading TDM program to reduce auto trips from new developments, including a robust TDM program planned for new developments in the National Landing area to provide a minimal number of parking spaces and incentivize transit, active modes of travel, and/or telecommuting
- Empirical observations from freeway deconstruction projects around the US, including projects in San Francisco, CA, and Milwaukee, WI, suggest that a reduction in traffic volumes may be observed if a limited-access freeway is converted to an at-grade boulevard

#### **Justifications for Sensitivity Analysis with Reduced Traffic Volumes**

##### **Historic Traffic Counts**

Traffic volumes along Route 1 have remained generally consistent during the past 15 years, even prior to the COVID-19 pandemic, as described previously in **Section 3.2** (and shown in **Figure 3-10**). Average daily traffic volumes along Route 1 just south of I-395 have remained generally consistent at approximately 50,000 vehicles per day (vpd). Additionally, historic traffic counts along other neighborhood streets in the Route 1 study area have also remained consistent or even shown a slight decrease over the past 15 years<sup>5</sup>.

##### **On-Going Multimodal Investments in National Landing Area**

The Commonwealth of Virginia, along with Arlington County, has committed to significant investments in transit and active mobility options in the National Landing area. A significant state investment is identified in the Commonwealth's SYIP for enhanced rail and transit in the Crystal City area, complementing local and regional investments. These investments have the potential to offset reduced vehicle capacity with use of other transportation modes. **Section 4.2**

---

<sup>5</sup> [https://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2020/09/DES-22202-Final\\_Report\\_2020\\_Update.pdf](https://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2020/09/DES-22202-Final_Report_2020_Update.pdf)

of this report highlighted the many planned investments in the National Landing area, with among the most notable being:

- **Transitway Improvements and Expansion:** The Transitway—a dedicated bus facility currently used by the Metroway BRT service through Crystal City—will be expanded north and west into Pentagon City, including dedicated bus lanes in some locations, allowing for premium, higher-capacity bus service to serve the corridor.
- **Crystal City VRE Station and Long Bridge:** The relocation and reconstruction of the Crystal City VRE station, along with the expansion of the Long Bridge rail connection across the Potomac River, will alleviate significant bottlenecks in the commuter rail system that currently limit the frequency and capacity of commuter rail service. These improvements will allow for planned more frequent VRE service and for longer trains to stop at the Crystal City station.
- **Potomac Yard Metro Station:** This new infill Metro station in the City of Alexandria just to the south of the National Landing area will provide an additional point of access for trips along the Route 1 corridor to access Metro, as currently there exists a gap in Metro access between the airport and Old Town Alexandria.

**Table 7-4** highlights the estimated capacity of parallel transit options to Route 1 as the study area transitions to a multimodal, people-focused corridor. From a review of these options and the on-going investments, the study team concluded that there is capacity in the future for shifting person trips from driving their personal vehicles along Route 1 to taking rail or bus transit to get to their destinations.

### Travel Demand Management in Arlington County

In addition to planned investments focused on non-auto travel modes, Arlington County is a national leader in implementation of TDM strategies, which focus on working with housing and employment providers to “provide commuters with a mix of reliable and affordable transportation options.”<sup>6</sup> TDM involves providing awareness of or incentivizing the infrastructure that is already in place for transit, ridesharing, walking, biking, and telework. Examples of TDM include discounted or free passes for transit and bikeshare; traveler information such as information displays showing transit arrival times; and dis-incentives for auto travel, such as working with developers to minimize the amount of parking provided and unbundling the cost of parking from housing. Prior to the pandemic, it was estimated that Arlington’s TDM program removes more than 50,000 solo car trips each workday<sup>7</sup>. The county has targeted the National Landing area—including several developments either recently opened, under construction, or planned—for aggressively implementing TDM strategies to significantly reduce the number of auto trips per unit.

Beyond Arlington County, there are also regional and state TDM programs, including the Commuter Connections program for the Washington, DC region (to which VDOT contributes

---

<sup>6</sup> <https://www.actweb.org/files/ACT/Policy/Benefits%20of%20TDM.pdf>

<sup>7</sup> <https://mobilitylab.org/2021/05/10/the-arlington-story-how-transportation-demand-management-provides-more-choices-and-encourages-behavior-change/>

funding). Commuter Connections offers several programs such as ride-matching for carpools and vanpools and working with employers to establish commuter benefit and assistance programs for their employees. VDOT and DRPT offer funding and other assistance for TDM programs and infrastructure such as park-and-ride lots, including in Arlington and surrounding areas.

DRAFT

**Table 7-4 Estimated Capacity of Parallel Transit Options**

Mode		Serves	Estimated Capacity (Persons moved per hour <i>in peak direction</i> )
	<b>Metro</b>	Fairfax, South Arlington/Alexandria ⇌ North Arlington/Washington, DC	15,000 to 20,000
	<b>VRE</b>	Fairfax/Prince William/Stafford/ Spotsylvania (or beyond) ⇌ Washington, DC	5,000 to 7,000
	<b>Amtrak</b>	Richmond ⇌ Washington, DC	700 to 1,000
	<b>BRT (Metroway)</b>	Old Town/Potomac Yard ⇌ Crystal City/Pentagon City	500 to 1,000

### Nationwide Examples of Conversions of Elevated Freeways to At-Grade Boulevards

Around the US, there has been a growing wave of discussion around removing grade-separated freeways in urban environments, especially in locations where those freeways have come to exist as real or perceived barriers in neighborhoods. There have been a few notable recent freeway de-construction projects that are either underway or already completed, while many have been proposed or are under study. The size and scopes of these projects vary, but in general, a freeway is replaced (or planned to be replaced) with a lower-capacity, at-grade facility aimed at reconnecting the urban fabric of its neighborhood. **Table 7-5** provides several notable examples that can be considered reasonably analogous to the proposed conversion of the Route 1 freeway to an at-grade urban boulevard.

In the three completed examples—the Embarcadero Freeway and Central Freeway projects in San Francisco, CA, and the Park East Freeway project in Milwaukee, WI—traffic volumes along the replacement at-grade section were significantly reduced in the years following the projects' completion. Rather than resulting in severe congestion or gridlock along the new at-grade section, these projects appear to have resulted in a dispersion of traffic among the grid of neighborhood streets, a shift in trips to other routes or modes, or an overall reduction in trip-making along these corridors. In all three of these examples, the removed freeway was a short freeway section connecting an urban neighborhood to a larger, longer-distance freeway, similar to Route 1 serving as a connection to the I-395 corridor to the north of the study area. However, it should be noted that these examples all feature robust parallel street grid networks in the neighborhoods adjacent to each project.

The fourth example shown in **Table 7-5**, the Alaskan Way viaduct in Seattle, WA, is still under construction, so its aftereffects have not been measured. Other examples of urban freeway removal projects are discussed in a piece by the Congress for the New Urbanism (CNU) called *Freeways Without Futures*, which is included this report's list of references in Appendix A.

**Table 7-5 Example Nationwide Elevated Freeways to At-Grade Projects**

Project Description	Traffic Volume Change		Project Take-Aways for Route 1 Study
	Before Freeway Removal	After Freeway Removal	
<b>Embarcadero Freeway</b> (San Francisco, CA)  <i>Freeway removal (2002) to at-grade urban boulevard due to earthquake damage</i>	AADT: 100,000+ in 1980s	AADT: 15,000 - 20,000 in 2010s	<ul style="list-style-type: none"> <li>Initial traffic congestion was absorbed to the adjacent street network (robust grid of streets)</li> <li>Transit ridership increased 15%</li> </ul>
<b>Central Freeway</b> (San Francisco, CA)  <i>Freeway removal (2002) to at-grade urban boulevard due to earthquake damage</i>	AADT: 93,000 in early 2000s	AADT: 45,000 in late 2000s	<ul style="list-style-type: none"> <li>Boulevard distributes traffic evenly throughout the immediate neighborhood (robust grid of streets)</li> <li>Several sample points in adjacent neighborhoods experienced decreases in traffic, while none experienced increases greater than 10%</li> </ul>
<b>Park East Freeway</b> (Milwaukee, WI)  <i>Freeway removal (2002) to at-grade urban boulevard due to under-utilization/desire to spur redevelopment</i>	AADT: 35,000 in 2000s	AADT: 23,000 - 26,000 in 2021	<ul style="list-style-type: none"> <li>Traffic congestion downtown remained "relatively modest" (given the robust grid of streets)</li> <li>Community development post-completion did not cause more congestion on the reduced-capacity boulevard</li> </ul>
<b>Alaskan Way</b> (Seattle, WA)  <i>Freeway removal (2019) to at-grade urban boulevard and tunnel due to obsolete existing structure</i>	Peak Hour Volume*: 6,000 (viaduct + surface street)	Forecasted Peak Hour Volume*: 5,500 (tunnel + surface street)	<ul style="list-style-type: none"> <li>Eight-lane above-grade viaduct being replaced with four-lane tolled tunnel; reconstructed surface boulevard to be completed this year</li> </ul>

### 7.5.3. Origin-Destination (O-D) Data

As shown in **Figure 7-12** below, during the weekday AM peak hour, approximately 50 to 60 percent of northbound trips along Route 1 near 23rd Street S are still on Route 1 north of 15th Street S, implying that more than 40 percent of trips along Route 1 have a start or end point somewhere *off of Route 1* near the study area. These turning movements onto and off of Route 1 need to be accounted for in any at-grade configuration without causing significant spillback onto side streets and nearby neighborhoods. At the same time, through trips along Route 1 can be targeted for a shift to parallel transit modes, especially given the planned investments in parallel transit options described previously.



**Figure 7-12 Northbound Route 1 O-D's, 2019 Weekday AM Peak Period (Source: StreetLight Data)**

As noted previously, the eastbound left turn from 15th Street S to northbound Route 1 carries a heavy volume of traffic during the weekday AM peak period.

**Table 7-6** looks at auto trips starting from three similar locations and their ultimate destinations during the AM peak period. More than one-third of vehicular trips starting in Pentagon City—including nearly 40 percent along eastbound 15th Street S—are destined for Washington, DC, while another nearly 10 percent are destined for the Rosslyn-Ballston corridor in northern Arlington County. These trips represent ideal targets for shifting to using Metro to reach their destination. Alternatively, more than 20 percent of trips along eastbound 15th Street S are destined for the Pentagon City or Crystal City neighborhoods. These trips could likely be targeted for a shift to a non-auto mode (e.g., walk, bike, scooter, or bus).

*Table 7-6 Route 1 Study Area O-D Percentages from Various Locations, 2019 Weekday AM Peak Period (Source: StreetLight Data)*

Origin Location	Destination				
	District of Columbia	Pentagon City/Crystal City Neighborhoods	Rosslyn/Ballston Corridor	Arlington County – Other	Outside of Arlington or DC
Pentagon City Neighborhood	36%	14%	8%	22%	20%
15th Street EB Between Eads and Route 1	39%	22%	7%	13%	19%
Route 1 NB On-Ramp from 15th	73%	2%	11%	2%	11%

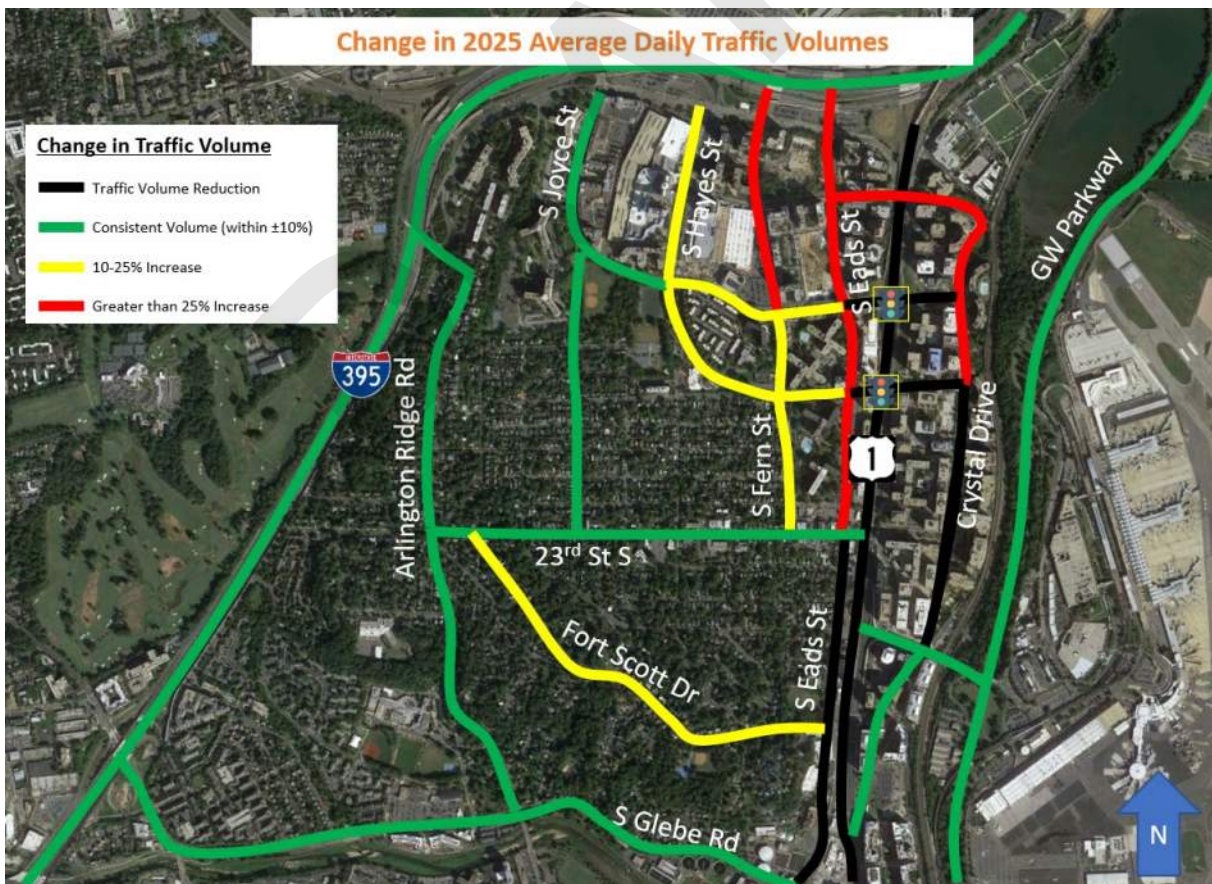
#### 7.5.4. Macro-Level Sensitivity Analysis: MWCOC Model Diversion Estimation

A proposed conversion of Route 1 in the study area to an at-grade configuration represents a reduction in vehicular capacity for the facility. While the traffic analyses contained in previous sections conservatively assumed that traffic volumes would be consistent with the No-Build Grade-Separated configuration for a worst-case analysis, it is likely that travel patterns would change in response to the change in network capacity. Some trips may divert to alternate routes, other trips may divert to alternate modes given the multimodal accommodations in the study area (e.g., investments in additional transit capacity and dedicated bicycle facilities), and some trips may not take place altogether.

The study team conducted a macro-level sensitivity analysis using the MWCOC travel demand model to estimate the change in traffic volume along Route 1 and adjacent study area streets given a reduction in capacity along Route 1. **Table 7-7** shows the resultant daily model volumes on select study area links compared between the two scenarios, while **Figure 7-13** shows these changes in map format. Within the study area, Route 1 shows a significant reduction in volume, most notably in the segments near the proposed new at-grade intersections. The most significant increases in volumes are along the nearby parallel streets—Crystal Drive, S Eads Street, and S Fern Street. Notably, the change in volume along the George Washington Parkway and I-395 is relatively minor given the large total volumes on these roadways. Furthermore, the total increase in volume on the parallel street network is much less than the decrease in volume along Route 1.

**Table 7-7 Change in MWCOG Model Daily Volume on Select Study Area Links, 2025 Model Year**

Facility		2025 Model Daily Volumes			
		No-Build	At-Grade	Change	% Change
Route 1	North of 15th	50,000	34,000	-16,000	-32%
	North of DCA	33,000	28,000	-5,000	-15%
GW Parkway		93,000	96,000	3,000	3%
I-395		215,000	217,000	2,000	1%
Crystal Drive		3,200	4,800	1,600	50%
S Eads Street		5,600	7,300	1,700	30%
S Fern Street		5,200	6,100	900	17%
S Hayes Street		12,900	14,400	1,500	12%
S Joyce Street		7,600	8,000	400	5%
Arlington Ridge Road		11,700	12,500	800	7%
23rd Street S		9,100	9,500	400	4%
Fort Scott Drive		900	1,000	100	11%
S Glebe Road		22,100	22,800	700	3%

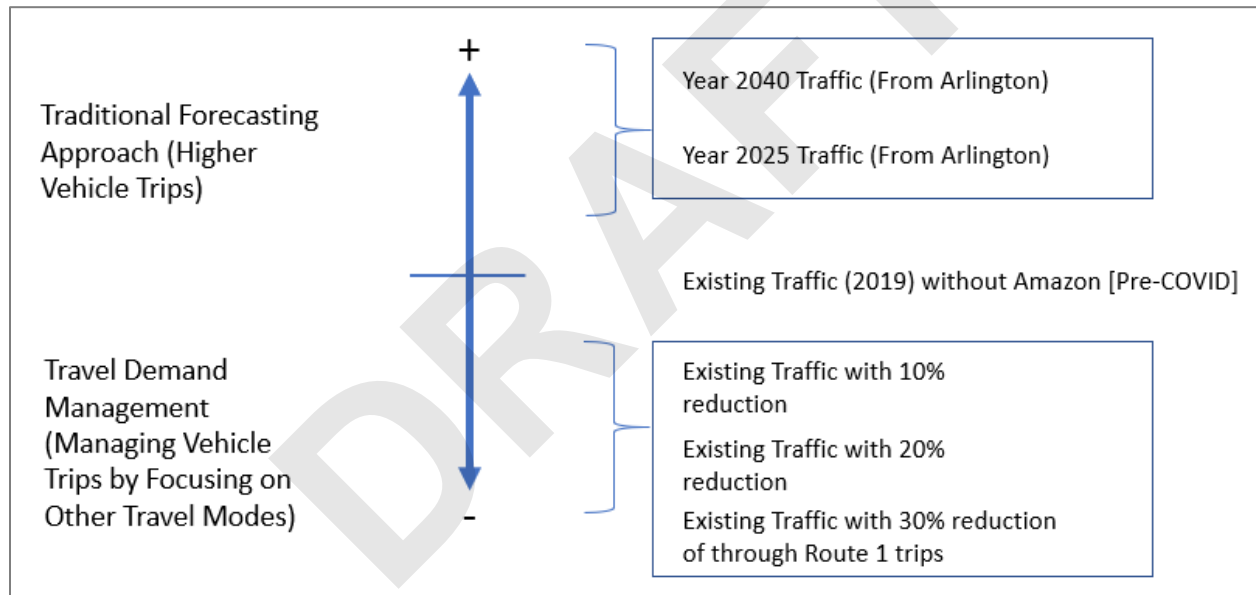


**Figure 7-13 Modeled Change in 2025 Average Daily Traffic Volumes with At-Grade Route 1**

### 7.5.5. Micro-Level Sensitivity Analysis – Vissim Model with Reduced Traffic Volumes

Given the considerations noted previously, a sensitivity analysis was run for At-Grade Build conditions focusing on a reduction in traffic volumes as compared to the Existing AM peak hour, which is the time period in which most operational challenges are shown to be present in the Build conditions for 2019 volumes. **Figure 7-14** shows the range of potential future traffic volume forecasts that were considered, with the high end of the spectrum encompassing the traditional forecasting approach rooted in a regional travel demand model that predicts future growth in traffic based on future growth in population and employment. At the other end of the spectrum, three sensitivity models (using At-Grade Build Option 1 as a representative example for simplicity) were developed testing reductions in traffic volumes from Existing (2019) volumes:

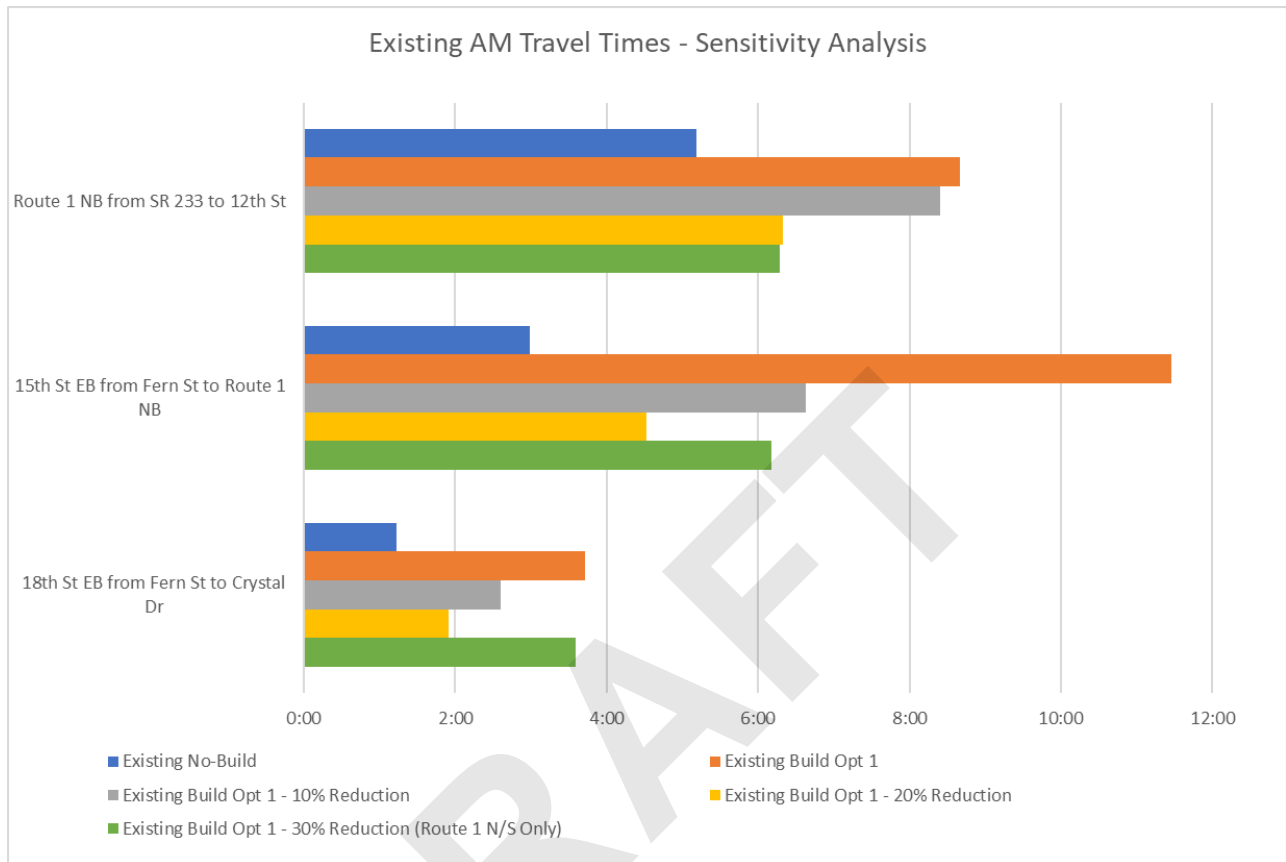
- 1) 10 percent reduction (network-wide)
- 2) 20 percent reduction (network-wide)
- 3) 30 percent reduction in north/south through trips along Route 1; no reduction to other movements/locations



**Figure 7-14 Range of Potential Future Traffic Forecasts Analyzed**

**Figure 7-15** shows travel times for the Existing (2019) AM peak hour for three select routes through the study area that carry heavy directional volumes during the AM peak and that showed a degradation in operations in the Build options using consistent traffic volumes with No-Build conditions. **Figure 7-16** shows side-by-side average speed heat maps for this same peak hour for the sensitivity analysis scenarios.

The results of the sensitivity analysis show that it will be important to target not just a reduction in through-traffic volumes along Route 1 but also network-wide volumes, including the neighborhood side streets.



**Figure 7-15 Key Study Area Travel Times, Existing (2019) AM Peak Hour Sensitivity Analysis**

### Option 1 AM Speed Comparison – Sensitivity Analysis

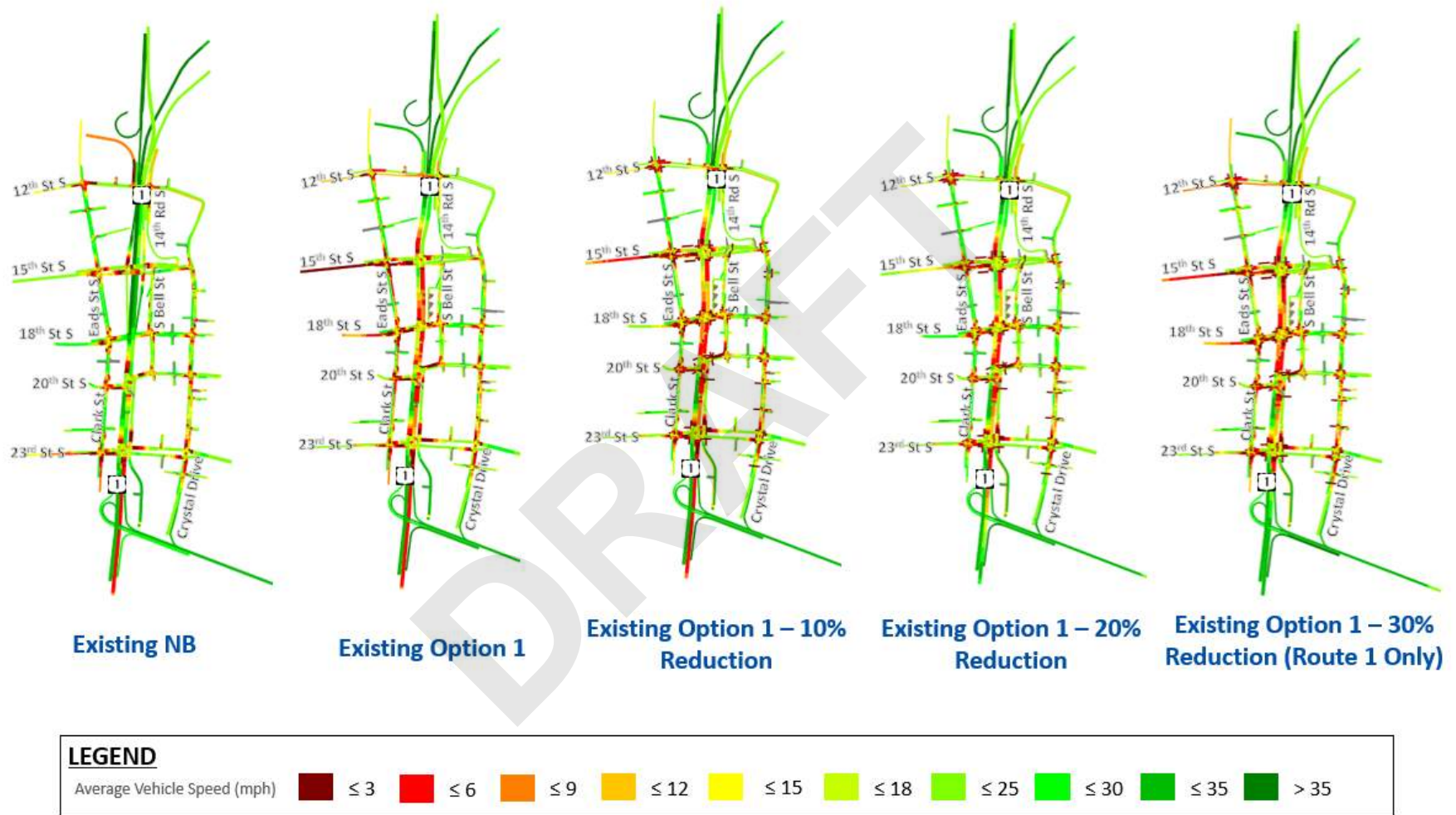


Figure 7-16. Existing (2019) AM Peak Hour Average Speed Comparison for Sensitivity Analysis Scenarios

The most noticeable changes in operations observed along the three select routes from the travel time figure are:

- **Northbound Route 1 from SR 233 to 12th Street S (through the study area)** – Given the presence of the new signalized intersections at 15th Street S and 18th Street S in the Build options, increases in northbound AM travel times are shown as compared to Existing No-Build conditions. The default Build Option 1 scenario with consistent traffic volumes shows an approximately 3-minute increase in Existing AM travel time for this route. With traffic volumes reduced by 10 percent network wide, travel times along this route stay relatively consistent with the default Build Option 1, although as shown on the chart, travel times are reduced significantly for cross-streets. With a 20 percent reduction in traffic volumes network wide, northbound Route 1 travel times are reduced to show less than a 2-minute increase over No-Build, and in the scenario with a 30 percent reduction in north/south Route 1 traffic only, the increase in travel times also is less than 2 minutes. These changes in travel time also can be observed in the speed heat map figure, with the most noticeable changes in speeds being along northbound Route 1 near 15th Street S and 18th Street S.
- **Eastbound 15th Street S from Fern Street to northbound Route 1 leaving the study area** – In the Build options, the signalized intersection of Route 1 and 15th Street S presents operational challenges during the AM peak due to the heavy volume of traffic that is going from eastbound 15th Street S to northbound Route 1. The default Build Option 1 scenario with consistent traffic volumes shows more than an 8-minute increase in travel time over No-Build for trips making this movement, with heavy queue spillback along eastbound 15th Street S which also affects S Eads Street. With traffic volumes reduced by 10 percent network-wide, travel times along this route significantly decrease—by more than 5 minutes. With a 20 percent reduction in traffic volumes network wide, travel times decrease by another approximately 2 minutes, resulting in an increase in travel time as compared to No-Build of approximately 1.5 minutes. The decreases in travel time for this route also can be observed in the speed heat map figure, with increases in speeds along 15th Street S to the west of Route 1. In the scenario with a 30 percent reduction in north/south Route 1 traffic only (and no decrease in side-street traffic volumes), the travel time reduction along this route is less pronounced but is still nearly 6 minutes less than the travel time in the default Build Option 1 scenario.

**Eastbound 18th Street from Fern Street to Crystal Drive** – Similar to the operational challenges along 15th Street S, in the Build options, the signalized intersection of Route 1 and 18th Street S results in queue spillback for eastbound traffic. The close spacing of the Route 1 signal and the S Eads Street signal result in queues that spill beyond the S Eads Street intersection and out of the network (to S Fern Street) in the default Build Option 1 scenario. The default Build Option 1 scenario with consistent traffic volumes shows a 2.5-minute increase in travel times along eastbound 18th Street S. Reducing traffic volumes by 10 percent and 20 percent result in decreases in travel times and increases in speeds along eastbound 18th Street

S. In the scenario with a 30 percent reduction in north/south Route 1 traffic only (and no decrease in side-street traffic volumes), there is not a significant change from the travel times and speeds in the default Option 1 scenario.

### 7.5.6. Pedestrian Capacity Considerations

One important consideration for converting Route 1 to an at-grade urban boulevard is the impact to pedestrians crossing Route 1 eastbound or westbound, including accounting for the expected significant growth in future pedestrian volume in the study area. **Table 7-8** presents the future forecasted crossing volumes at the two proposed at-grade intersections, which includes accounting for Amazon HQ2 and adjacent developments as well as the estimated capacities<sup>8</sup> for the crossings of Route 1. As shown, even given the significant growth in pedestrian volumes forecasted, the At-Grade Build concepts should have sufficient capacity to accommodate 2040 demand.

**Table 7-8 Comparison of Forecasted Pedestrian Volumes to Estimated**

EB/WB	Existing Ped Volume (2040 PM Peak)	Forecasted Ped Volume (2040 PM Peak)	Estimated Ped Capacity of EB/WB Crossing of Route 1	
			Existing/No-Build	At-Grade Build Concepts
15th	60	300	5,200	1,200 to 1,700
18th	630	1,270	8,000	1,400 to 1,700

### 7.5.7. Safety and Crash Evaluation

A safety analysis was conducted for Route 1 within the project study area, including the Route 1 limited-access freeway south of I-395 and signalized intersections in the core street study area. Predictive methods using tools based on the *Highway Safety Manual* (HSM) were used to estimate future-year crashes for No-Build conditions against various Build options.

Crash predictions were developed for the following scenarios:

<sup>8</sup> The *Global Street Design Guide* estimates that the hourly pedestrian capacity of a 3-meter-wide (approximately 9-to-10-foot-wide) sidewalk is approximately 8,000 to 9,000 pedestrians per hour, which is the most conservative estimate of pedestrian capacity of sources reviewed. Assuming the low estimate of 8,000 pedestrians per hour for a facility without any delay (i.e., traffic signals), the capacity of the at-grade crossings was estimated by multiplying this 8,000 peds/hour value by the green time to cycle length (g/C) ratio at each signal for the east-west through movements.

- No-Build
- Build (using Arlington County forecasts, consistent with No-Build conditions) – At-Grade Options 1, 2, and 3
- Build (using reduced traffic volume forecasts based on the MWCOG traffic diversion sensitivity analysis) – At-Grade Options 1, 2, and 3

For reference, at-grade Build Options 1, 2, and 3 are shown in detail in **Section 6.6**.

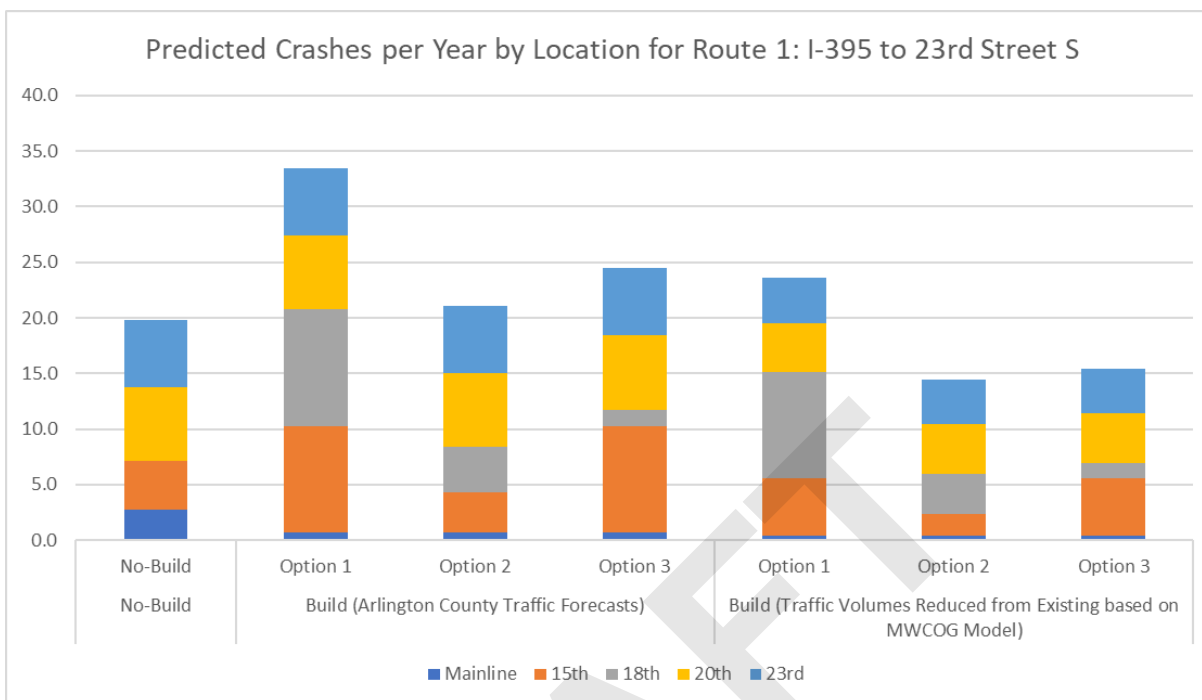
The crash prediction model featured refinements accounting for the existing crash history in the study area as well as adjustment factors applied to the Build scenarios to account for the proposed reduction in speed limit along Route 1 and removal of left turns in certain scenarios.

**Figure 7-17** shows the future predicted crashes per year (average crashes per year from 2021 to 2040) for all modes broken out by location in the study area for the scenarios described previously. All three Build options result in an increase in crashes when using the Arlington County traffic forecasts (i.e., using consistent traffic volumes with the No-Build condition), mainly due to an increase in crashes at the new intersections with 15th Street S and 18th Street S. Note that Options 2 and 3 show a reduction in crashes as compared to Option 1 due to the removal of left turns at one or more intersections. The Build options do show a reduction in crashes along the Route 1 mainline, as the weave area just south of I-395 is mitigated. Using the reduced traffic volume forecasts for the Build options, the total number of crashes in the study area is predicted to be slightly higher than No-Build for Option 1 and slightly lower than No-Build for Options 2 and 3, due to the removal of left turns at certain intersections in those options.

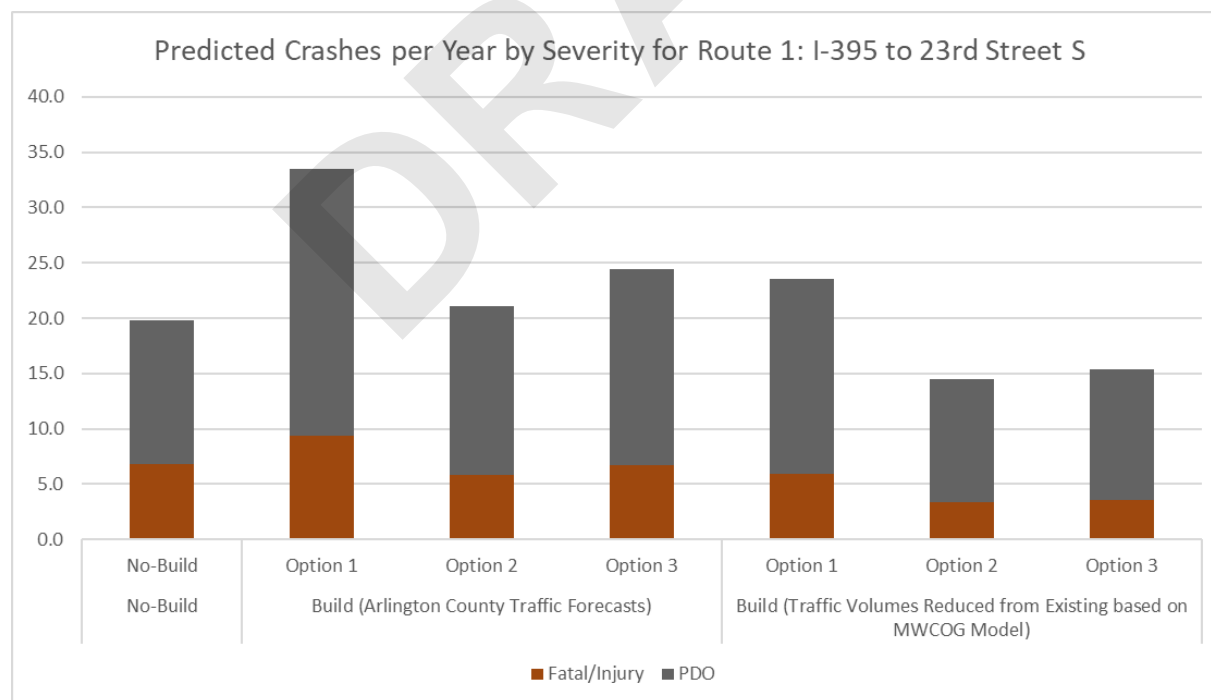
**Figure 7-18** shows the future predicted crashes per year (average crashes per year from 2021 to 2040) for all modes broken out by crash severity (fatal/injury or PDO). The annual crash totals are consistent with the previous figure. Note that with the Arlington County forecasts, although the total number of crashes in the Build options increases over the No-Build condition, the increases are mainly PDO crashes, as the reduced speed limit and removal of left turns (in some options) provide a reduction in severe crashes. Using the reduced traffic volume forecasts for the Build options, a decrease in fatal/injury crashes is predicted for all three options.

**Figure 7-19** shows only the predicted bicycle and pedestrian crashes per year (average crashes per year from 2021 to 2040). In all scenarios, most of these crashes are predicted to be pedestrian crashes, given the high pedestrian volumes forecasted crossing Route 1. With the Arlington County forecasts, the number of bicycle and pedestrian crashes increases for all Build options as compared to the No-Build condition. However, with the reduced traffic volume forecasts, the number of bicycle and pedestrian crashes is predicted to only be slightly higher than No-Build for Option 1 and slightly lower than No-Build for Options 2 and 3, due to the removal of left turns at certain intersections in those options. Note that in the No-Build condition, no bicycle and pedestrian crashes are predicted at the two signalized intersections along 15th Street S that are part of the existing diamond interchange, as the Interactive Highway Safety Design Model (IHSDM) does not include this type of crashes in the outputs for freeway ramp terminals (likely due to a lack of empirical data). However, as noted in **Appendix C, Existing**

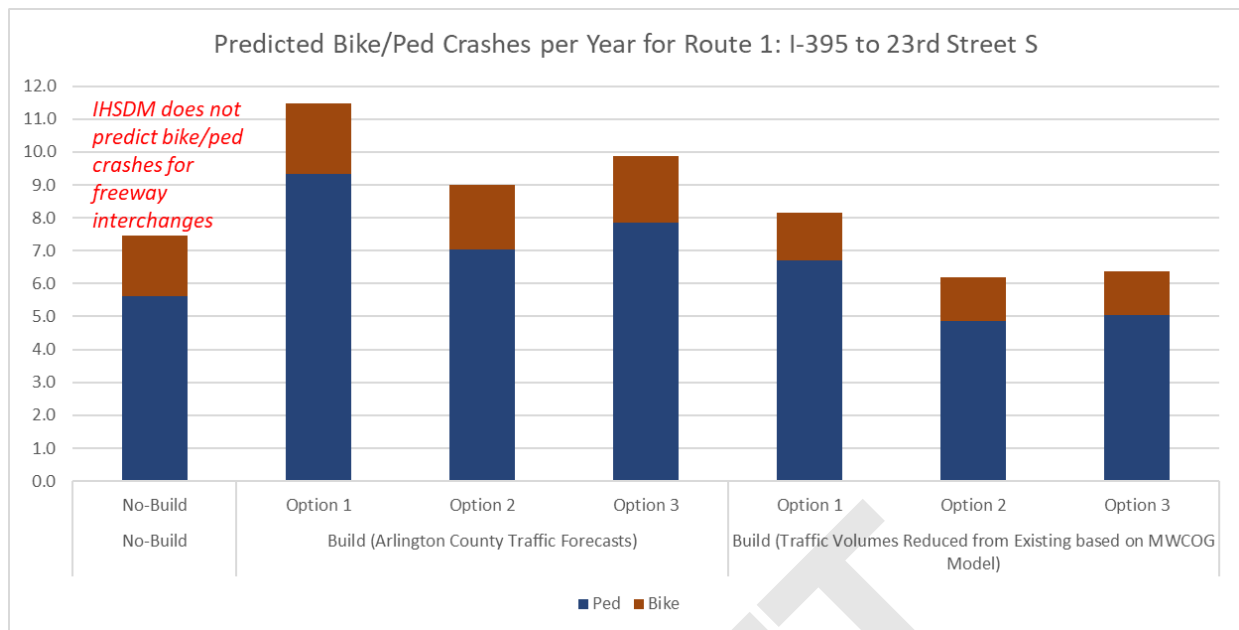
**Conditions Summary Report**, in the years 2015 to 2019, no bicycle or pedestrian crashes were observed at those intersections.



**Figure 7-17 Predicted Crashes per Year by Location for Route 1, I-395 to 23rd Street S**



**Figure 7-18 Predicted Crashes per Year by Severity for Route 1, I-395 to 23rd Street S**



**Figure 7-19 Predicted Bicycle and Pedestrian Crashes per Year for Route 1, I-395 to 23rd Street S**

## 7.6. Concept Evaluation Summary

The refined potential corridor concepts—at-grade Options 1, 2, and 3, the Sector Plan concept, and the modified existing conditions concept—were evaluated for feasibility based on analyses of constructability, stormwater management, developable land, planning-level costs, traffic operations, and safety. From the findings, the next chapter discusses conclusions and VDOT’s recommendations for an urban boulevard to be constructed in the context of existing and planned land uses and other multimodal transportation improvements in Crystal City.

## 8. Conclusions and Recommendations

Virginia Department of Transportation (VDOT) is taking the lead to develop and analyze appropriate solutions for converting Route 1 to a multimodal, urban boulevard—either elevated or at grade—by removing this segment of urban freeway, embracing Route 1 as a city street with storefronts and building entrances, and knitting together the urban fabric of Crystal City. This Phase 1 of the Route 1 Multimodal improvement Study has evaluated the feasibility of solutions for improving safety, accessibility, and the pedestrian experience in this corridor, while continuing to serve travelers who use the road for traveling to regional destinations.

The Phase 1 study has been guided by the 2010 *Crystal City Sector Plan* and its recommendation for an elevated urban boulevard that could be constructed to integrate 3-dimensionally with redevelopment projects on either side of the roadway. Pivoting from this plan, this Phase 1 study also has been inspired by national trends and the local vision to remove this segment of elevated urban freeway altogether and create a walkable, connected, urban downtown, while also providing better and safer pedestrian connections across and along Route 1.

Considering this guidance, the VDOT study team examined the feasibility of three possible future Route 1 configurations:

- Modified existing grade-separated Route 1 with lower-cost safety enhancements
- Route 1 urban boulevard with at-grade intersections at 15th Street S and 18th Street S
- Route 1 urban boulevard with a revamped interchange at 15th Street S and a new bridge over 18th Street S, mimicking the Sector Plan concept

Stakeholder engagement was a critical component of this transportation study, and VDOT offered multiple opportunities for stakeholder agencies and the public to provide input during this Phase 1 of this study. This input guided the development and analysis of urban boulevard concepts and the findings and conclusions, which are discussed in this section and followed by a discussion of VDOT's recommendations and next steps in the study and implementation process.

### 8.1. Conclusions on Project Need

The deliberate process to reach the conclusions discussed in this section of the Phase 1 study report began with understanding the history and context of the Route 1 study area. From this understanding, the study analyzed existing conditions in coordination with local stakeholder groups and agencies; conducted design and transportation feasibility analyses for auto and non-auto uses; and identified feasible scenarios for further consideration. Public input was considered for developing urban boulevard concepts, analyzing these concepts, and ultimately comparing them to this study's measures of effectiveness (MOEs).

From the analysis of existing and future transportation conditions in the Route 1 corridor in Crystal City, this relatively short segment of urban freeway currently allows pedestrians, bicyclists, transit users, and traffic to cross under Route 1; however, the freeway makes walking or biking along Route 1 difficult and uncomfortable and creates a disjointed grid of streets. The

densities of commercial, residential, and other land uses will continue to increase significantly in the future. The existing Route 1 corridor, while operating relatively efficiently for vehicles and buses today, lacks walkability and other qualities consistent with stakeholders' vision for Crystal City. Existing vehicular and non-auto uses are disjointed, separated by elevation and a lack of multimodal connectivity.

There is a need to increase safety for all users including pedestrians, bicyclists, transit riders, and motorists, while also improving multimodal accessibility throughout Crystal City, particularly to transit stations. Increased multimodal accessibility will improve person throughput for the corridor, which also should improve the pedestrian experience for people traveling across and along Route 1.

## 8.2. Conclusions on a Possible Route 1 Urban Boulevard

In considering possible configurations of a Route 1 urban boulevard, the study considered the Crystal City Sector Plan's elevated configuration and grade separations at 15th Street S. and 18th Street S., developed and refined a grade-separate Sector Plan concept, and the conducted a feasibility analysis of this concept plan.

Given that the at-grade urban boulevard configurations had not been previously recommended by the 2010 *Crystal City Sector Plan*, the study team identified initial at-grade scenarios of varying alignments, profiles, and intersection configurations. After vetting of initial ideas with stakeholders and the public, concepts that included multiple left turn lanes or right turn only lanes were discarded. Concepts that minimized pedestrian crossing distances were favored. From this vetting and the analysis of feasibility, three at-grade concepts emerged that were considered feasible.

When combined with the grade-separated Sector Plan concept, the following four concepts moved forward with further refinement and analysis:

- **At-Grade Configuration – Option 1:** All turning movements permitted at 15th and 18th Streets
- **At-Grade Configuration – Option 2:** Left turns from Route 1 prohibited at 15th and 18th Streets, which narrowed the Route 1 typical section to 6-lanes providing a wider center median with additional plantings possible
- **At-Grade Configuration – Option 3:** A “hybrid” Options 1 and 2 with left turns at Route 1/15th Street, no left turns at Route 1/18th Street) included at request of Arlington County staff, which became At-Grade Option 3
- **Grade-Separated Sector Plan Configuration:** Modified single-point urban interchange (SPUI) at 15th Street S, with ramps on the inside of the Route 1 travel lanes (i.e., an “inverted SPUI”), and a grade-separated overpass at 18th Street S

The examination of these four concepts involved feasibility analyses based on the goals of this study to incorporate safety, multimodal access and accommodation, transit effectiveness, vehicular operations, and environmental features, all to fit within the urban fabric and context of Crystal City. The analyses resulted in the following conclusions:

- **All four concepts are constructable.** Both the at-grade concept design scenarios (Options 1–3 ) and the grade-separated Sector Plan concept would involve the removal of the existing Route 1 bridges over 15th Street S and 18th Street S, with the At-Grade concept replacing these crossings with signalized intersections and the Grade-Separated concept constructing new single-span bridges. Both concepts appear to be constructible while maintaining pedestrian, bicycle, transit, and vehicular traffic patterns. The Grade-Separated concept would require adjusting the profile of the Route 1 corridor to account for the increased superstructure depth of the new single-span bridges as well as noncompliant *existing* vertical clearance issues.
- **Stormwater management is feasible with each concept.** Both the At-Grade concept design scenarios (Options 1–3) and the Grade-Separated Sector Plan concept were found to reduce the overall flow as compared to existing conditions due to the significant reduction in impervious area from both concepts. Due to the reduction in impervious area, neither scenario is anticipated to require major BMP facilities. The water quality and quantity needs can be met through the mix of reducing impervious area for water quantity and purchasing nutrient credits to meet the water quality requirements. It is estimated that the At-Grade concept would result in the lowest cost for nutrient credits as it results in less impervious area.
- **More developable land is possible with the Build concepts.** Both the At-Grade concept design scenarios (Options 1–3) and the Grade-Separated Sector Plan concept tighten the width of the corridor using urban design standards and narrower lanes to create additional developable land on both sides of the corridor. The At-Grade concept provides for approximately 6-1/2 acres of developable land, approximately 1-1/2 more acres than the Grade-Separated concept due to the additional curvature of the Route 1 alignment and the removal of ramps and infrastructure associated with the interchange at 15th Street S.
- **The pedestrian zone will be able to provide ample room for sidewalks, street trees, and other amenities.** This element of a potential Route 1 urban boulevard cross section is the area between the street curb and the building façade (or other adjacent land use). The dimension of this zone is between 20 feet and almost 30 feet, depending on which concept moves forward. It is feasible that each of the four concepts can accommodate wide sidewalks, street trees, other landscaping, pedestrian-level lighting, benches and other outdoor furniture, and space for outdoor café seating. Thus, each of the concepts provides a wide, flexible space that provides options in the future for what would best meet the needs of the community, the traveling public, and adjacent landowners.
- **Planning-level cost estimates indicated that at-grade concepts are less costly.** Planning-level cost estimates were developed accounting for preliminary engineering, construction, right-of-way, and utilities using standard VDOT costing methodologies. It is estimated that the At-Grade concept would cost approximately \$180 million, while the Grade-Separated concept would cost approximately \$260 million. Modifying the existing configuration with modest safety and infrastructure improvement could cost between \$5 and \$15 million.

- **Multimodal transportation and safety analyses revealed concerns with the at-grade concepts.** From a feasibility perspective, an at-grade Route 1 is anticipated to result in changes to travel patterns, traffic operations, and safety across all modes in the study area.
  - In general, it is anticipated that operational and safety challenges would be manifested with an at-grade Route 1 if traffic volumes remain consistent with 2019 (pre-pandemic) volumes or increase in the future, which is how future-year traffic operations are typically analyzed. However, this type of analysis likely represents a conservative “worst case” analysis that does not account for considerations such as significant planned investments in parallel transit service to Route 1. Most notably, empirical evidence exists from a limited number of freeway-to-at-grade conversion projects around the US that traffic volumes decrease given the reduction in capacity, and trips are absorbed into the local street network or diverted to other modes.
  - Should traffic volumes in the study area decrease in conjunction with an at-grade concept implementation, it would be anticipated that multimodal transportation operations and safety would not be significantly adversely affected. Some minor increases in vehicle peak-hour travel times and delays would still be anticipated due to the removal of grade-separated crossings. Depending on the specific at-grade design, as well as future traffic volumes, the predicted future number of crashes along the corridor would not show a significant increase or could even show a decrease, given that the at-grade concept includes a reduction in the study area speed limit and design speeds, mitigates an existing weaving area between I-395 and the 15th Street S interchange, and provides a relatively short pedestrian crossing of Route 1 at 18th Street S.

From these conclusions, of the three options for the At-Grade Urban Boulevard, Option 3 was chosen as the optimum concept given the following reasons:

- Option 3 provides all turning movements to/from Route 1 at 15th Street S, thus addressing multimodal transportation demand
- Option 3 limits left turn movements the Route 1/18th Street S intersection, which removes several conflict points with pedestrian crossings, decreases the number of traffic signal phases, and maximizes pedestrian crossing times
- Option 3 (and all at-grade concepts) would include speed reduction mitigations for vehicles coming from I-395 and Route 110, including signage, pavement markings, and more active measures such as speed feedback signs.

### 8.3. Comparisons with Measures of Effectiveness

The At-Grade (Option 3), Grade-Separated Sector Plan, and Modified Existing configurations were evaluated using the MOEs and rated based on their relative impacts as compared with the existing configuration. Based on these comparisons, the study team drew the following conclusions:

- **Safety (Crashes):**

- *At-Grade*: Due to the introduction of new signalized intersections, there are new conflicts points created and hence more potential for crashes. However, the At-Grade design has the opportunity to reduce the crash potential through the lower posted speed limit, restricted left-turn movements at the Route 1 and 18th Street S intersection (Options 2 and 3), and reduced number of vehicle trips a result of a robust travel demand management (TDM) program.
- *Sector Plan Concept*: The number of crashes should be slightly reduced due to reduction in speed and reduced conflict points at 15th Street with the inverted single-point urban interchange (SPUI) configuration.
- *Modified Existing*: The number of crashes should be slightly reduced with enhancements to the existing infrastructure primarily through a reduction in speed along Route 1 from 35 mph to 30 mph, as well as additional/upgraded signage, lighting, and pavement markings.
- **Walkability:**
  - *At-Grade*: Walkability will improve with the addition of wide pedestrian facilities along each side of Route 1 where none or few currently exist today. While a new signalized intersection will be added at Route 1 and 18th Street S, one signalized intersection will be removed along 15th Street S with the removal of the Route 1 interchange.
  - *Sector Plan Concept*: Walkability will improve with the Sector Plan concept with the addition of wide pedestrian facilities along Route 1. Along 15th Street S, the two existing signalized intersections will be combined into one. However, moving from sidewalks along Route 1 to sidewalks along 15th or 18th Street will require extensive ramps, stairs, and elevators.
  - *Modified Existing*: Walkability will remain the same as the existing conditions, that is, the existing sidewalks are disjointed and provide limited accessibility.
- **Bikeability:**
  - *At-Grade*: While bikeability will be improved with the new westbound bike lane along 15<sup>th</sup> Street S, a new signalized intersection at Route 1 and 18<sup>th</sup> Street S will impact bikeability. Further, the community expressed interest in adding bicycle facilities along Route 1 if it is converted to at-grade. The decision for bicycle facilities will need to be addressed at a later time in coordination with Arlington County. If bicycle facilities are provided, then the bikeability will be improved.
  - *Sector Plan Concept*: Bikeability will be improved with the new westbound bike lane along 15<sup>th</sup> Street S.
  - *Modified Existing*: Bikeability will be improved with the addition of a new westbound bike lane along 15<sup>th</sup> Street S.
- **Transit Effectiveness:**

- *At-Grade*: Bus operations may be impacted if vehicle trips increase in the future and congestion occurs. However, bus operations may have impacts minimized with an effective travel demand management strategy.
- *Sector Plan Concept*: Buses will generally operate as they do today under the existing roadway geometry.
- *Modified Existing*: Buses will generally operate as they do today under the existing roadway geometry.
- **Vehicle Traffic Operations:**
  - *At-Grade*: Vehicle operations may be impacted if vehicle trips increase in the future and congestion occurs. However, vehicle operations may have impacts minimized with an effective travel demand management strategy.
  - *Sector Plan Concept*: Vehicle traffic operations will generally operate as they do today under the existing roadway geometry.
  - *Modified Existing*: Vehicle traffic operations will generally operate as they do today under the existing roadway geometry.
- **Pedestrian Operations/Safety:**
  - *At-Grade*: Pedestrian operations/safety may worsen with the at-grade intersections. However, lowering the Route 1 speed limit and restricting left turns at the Route 1 and 18th Street S intersection may improve overall safety in the corridor in addition to considering a pedestrian overpass or underpass along 18th Street S at Route 1.
  - *Sector Plan Concept*: Pedestrian operations/safety will generally operate as they do today under the existing roadway geometry.
  - *Modified Existing*: Pedestrian operations/safety will generally operate as they do today under the existing roadway geometry.
- **Shift in Trips to Non-Auto Modes:**
  - *At-Grade*: The reduced Route 1 capacity will encourage more travelers to shift modes especially when combined with an effective travel demand management plan.
  - *Sector Plan Concept*: No expected change.
  - *Modified Existing*: No expected change.
- **Cost:**
  - *At-Grade*: Estimated to be \$180 million plus the cost of a travel demand management plan and pedestrian overpass/underpass (if found feasible).
  - *Sector Plan Concept*: Estimated to be \$260 million.
  - *Modified Existing*: Estimated to be \$5–15 million.
- **Constructability:**

- *At-Grade*: Will likely require a six-phase construction sequence with bridge removal and temporary traffic signals.
- *Sector Plan Concept*: Will likely require a six-phase construction sequence with bridge removal, bridge reconstruction, retaining wall reconstruction, and temporary traffic signals.
- *Modified Existing*: Will be the easiest to construct since it will not require roadway reconstruction or bridge replacement.
- **ADA Considerations:**
  - *At-Grade*: Improved accessibility due to the new pedestrian facilities along Route 1. Connections from Route 1 to cross streets will be at grade. All facilities would be brought into ADA conformance.
  - *Sector Plan Concept*: Improved accessibility due to the new pedestrian facilities along Route 1. Connections from Route 1 (elevated) to cross streets will be either elevators or ramps. All facilities will be brought into ADA conformance.
  - *Modified Existing*: Generally similar ADA access as the existing roadway geometry.
- **Urban Fabric:**
  - *At-Grade*: Rebuilding the roadway at-grade will provide more opportunities to enhance the urban experience and interfaces with new buildings.
  - *Sector Plan Concept*: Rebuilding the elevated roadway will provide opportunities to enhance the urban experience and interfaces with new buildings; however, the elevated segment of Route 1 would continue to act as an east-west barrier.
  - *Modified Existing*: Modifications to the pedestrian areas under the bridges will enhance the urban experience; however, the elevated urban freeway would remain as an east-west barrier.
- **Redevelopment Potential:**
  - *At-Grade*: Creates the most opportunities for redevelopment potential as it would result in the largest amount of excess land.
  - *Sector Plan Concept*: Creates some opportunities for redevelopment potential as it would result in some excess land.
  - *Modified Existing*: Does not create new opportunities for redevelopment potential.
- **Adaptability:**
  - *At-Grade*: Provides the most opportunity for adaptation in the future (such as bus-only lanes, on-street parking, bicycle facilities, etc.)
  - *Sector Plan Concept*: Does not provide opportunities for adaptation in the future.
  - *Modified Existing*: Does not provide opportunities for adaptation in the future.
- **Environmental Impacts:**

- *At-Grade*: Provides additional street trees and landscaping considering a biophilic design approach. Reduces the amount of impervious area more-so than the existing and Sector Plan scenarios, thereby having the lowest impact on stormwater management.
- *Sector Plan Concept*: Provides additional street trees and landscaping considering a biophilic design approach. Reduces the amount of impervious area as compared to the existing conditions.
- *Modified Existing*: Limited/no impacts due to limited construction.
- **Maintenance:**
  - *At-Grade*: Lowest maintenance due to the removal of bridge structures.
  - *Sector Plan Concept*: Greater maintenance impacts due to additional structures required.
  - *Modified Existing*: Generally similar maintenance as compared to the existing roadway geometry.
- **Consistency with National Landing Vision:**
  - *At-Grade*: Generally consistent with the vision of the National Landing BID and other stakeholders of an at-grade urban boulevard with street level bicycle and pedestrian facilities, creating a walkable, connected, urban downtown.
  - *Sector Plan Concept*: Inconsistent with the National Landing vision due to grade separation and disjointed roadway with urban development features.
  - *Modified Existing*: Inconsistent with the National Landing Vision due to grade separation and disjointed roadway with urban development features.

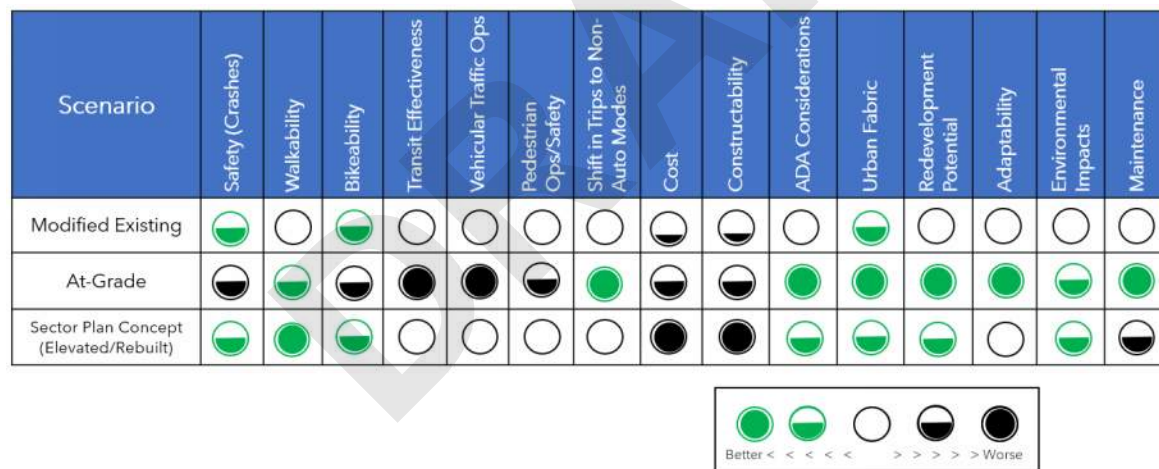
The comparisons of the At-Grade, Grade-Separated Sector Plan, and Modified Existing configurations to selected MOEs is summarized in **Table 8-1** below. Note that the At-Grade Urban Boulevard (Option 3) is the least cost urban boulevard configuration and the one that is most compatible with the vision for National Landing. Pedestrian safety concerns will need to be address with further study, and a TDM strategy is needed to mitigate the potential for traffic congestion to affect the safety and efficiency of other modes.

**Table 8-1 Comparison of Possible Route 1 Urban Boulevard Configurations with Selected MOEs**

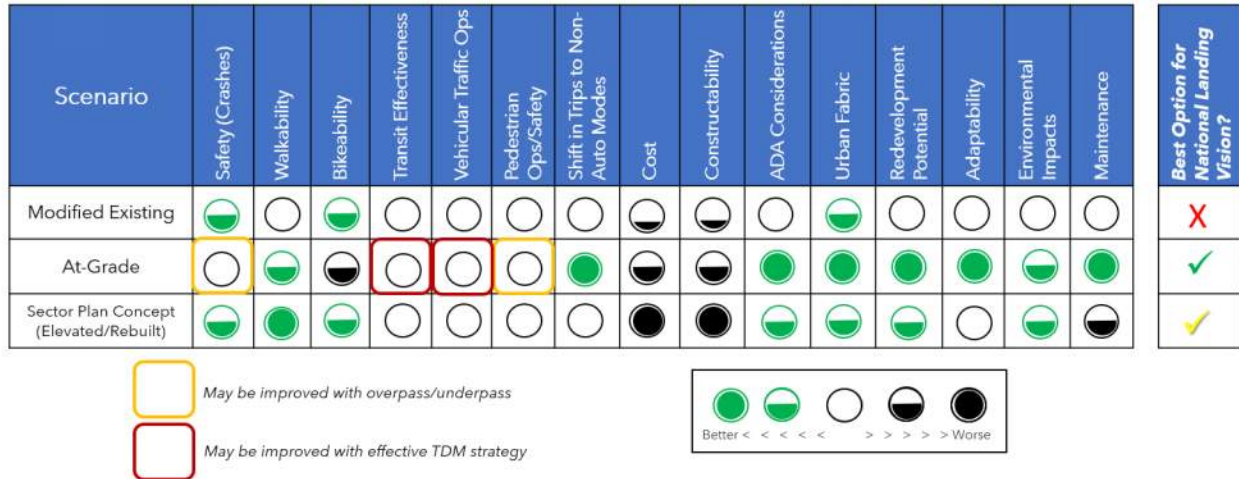
Configuration	Pedestrian Safety	Multimodal Traffic Demand	Project Cost	Urban Boulevard	Vision for National Landing
At-Grade Urban Boulevard	Concerns need to be addressed w/ further study	Needs strategy that reduces future traffic volumes	Moderate \$180M	Yes	Compatible

Configuration	Pedestrian Safety	Multimodal Traffic Demand	Project Cost	Urban Boulevard	Vision for National Landing
Elevated Urban Boulevard (Sector Plan)	Accommodates	Accommodates	High \$260M	Yes	Impedes future development of National Landing
Improved Existing Elevated Roadway	Accommodates	Accommodates	Low \$5-15M	No	Not compatible

The comparisons of the three possible urban boulevard configurations using the MOEs can be translated to ratings when compared to the existing configuration. **Figure 8-1** shows the initial ratings of each of the possible concepts. When considering possible actions such as the implementation of a robust TDM strategy or a grade-separated pedestrian bridge or underpass at 18th Street S, some of the ratings may be improved. **Figure 8-2** shows these possible improvements.



**Figure 8-1 Initial MOE Comparison of Possible Route 1 Urban Boulevard Configurations**



**Figure 8-2 MOE Comparisons with Possible Safety and Operations Mitigations**

#### 8.4. Recommendation: At-Grade Configuration Option 3

From the findings and conclusions of this Phase 1 study, and based upon the comparisons of the concepts using the 15 MOEs discussed above, it is VDOT's recommendation to convert the segment of elevated urban freeway in Crystal City to an at grade, tree-lined urban boulevard with wide spaces along Route 1 for sidewalks, street trees, lighting, and other amenities desired by Arlington County citizens and land owners—and with safe crossings of Route 1 for pedestrians, bicyclists, and other users. An at-grade configuration for Route 1 provides most desirable characteristics that meet the multimodal and community vision for National Landing.

It is believed that this scenario will provide the greatest benefit to the corridor in the context of an evolving walkable, connected, and urban Crystal City. The at-grade scenario weighed vehicle throughput, and corridor levels of service with that of environmental sustainability, walkability, redevelopment potential all while considering a safe scenario for all users.

It is further recommended that the At-Grade Option 3 scenario (at-grade configuration with all turns at 15th Street S and no left turns at 18th Street S) be moved forward into the second phase of study for further consideration. Based upon the conclusions discussed above and the findings of the analyses documented in this report, Phase 2 will include the development of a robust TDM strategy, which is will be need to reduce future traffic volumes below existing (2019) volumes and to mitigate future congestion and potential diversion of traffic onto local and regional roads. Phase 2 will also examine a potential pedestrian underpass or overpass at 18th street.

This recommended at-grade configuration is consistent with the national trend to remove urban freeways to create more vibrant street spaces, healthier environments, and increased economic opportunities. A plan view of the recommended configuration is shown in **Figure 8-3**.

Renderings of this recommended configuration are shown in **Figure 8-4** through **Figure 8-6**.



*Figure 8-3 Recommended At Grade Urban Boulevard Configuration with Future Multimodal Transfer Facility, Pedestrian Facilities, and Bicycle Facilities*



**Figure 8-4 Rendering of Recommended At Grade Urban Boulevard at 15th Street S Looking Southwest**



**Figure 8-5 Rendering of Recommended At Grade Urban Boulevard at 18th Street S Looking Northwest**



*Figure 8-6 Rendering of Recommended At Grade Urban Boulevard at 15th Street S Looking South*

The recommended concept provides for a reconstructed Route 1 that will provide:

- Walkable access along Route 1 between 15th Street S and 20th Street S to buildings, parks, and transportation facilities
- Wide, high-visibility pedestrian crosswalks and bicycle crossings of Route 1, with pedestrian refuges and shorter crossing distances than exist today.
- Accommodations for vehicles and buses while providing opportunities for wide sidewalks and other amenities along Route 1 that will embrace the future fronts of buildings
- Consistency with the vision for National Landing, i.e., for knitting together the urban fabric, providing a safe environment for all modes, and enhancing economic vitality in the corridor.
- Quantities of items that would result from implementation of the at-grade configuration:
  - 2,100 linear feet of bike lanes
  - 1,135 linear feet of crosswalks with wide pedestrian refuges
  - 8,000 linear feet of sidewalks—including 3,250 linear feet of new sidewalk
  - 124,000 square feet (2.8 acres) of walkable pedestrian space
  - 1,600 linear feet of new medians

- 190 new trees along Route 1
- 78,000 square feet (1.8 acres) of landscaping
- Removal of 85,000 square feet (1.9 acres) of pavement
- 6.5 acres of excess right-of-way that may be converted to residential, office, or commercial land uses and/or parks and open space

## 8.5. Next Steps

This report has been written to document VDOT's processes, findings, and conclusions of the of the first study phase of the Route 1 Multimodal Improvements project in Crystal City. Given the feedback from Route 1 Task Force members and many other stakeholders—including local residents of the neighborhoods in the 22202 zip code—as this report is finalized, VDOT will move into a second phase of the study, with the ultimate goal of implementing solutions that will create a safe, comfortable, urban boulevard in concert with transportation improvement projects being implemented in Crystal City by Arlington County and with redevelopment projects being implemented by landowners.

The anticipated Phase 2 tasks are anticipated to include:

- Development of a TDM Strategy – in coordination with statewide transit investments (Virginia Department of Rail and Public Transportation [DRPT] and Transforming Rail in Virginia [TRV]) and with Arlington County and their transit and street space investments, including reduced parking supply, increased travel choices (aligned with desired travel patterns)
- Additional analysis of Route 1 using the results of the Pentagon City Planning Study (which is increasing density beyond what Route 1 phase 1 has assumed)
- Feasibility of separate pedestrian and bicycle crossing under or over Route 1
- Relocation of bus bays from 18th Street S and potentially rerouting buses, likely to involve planning and concept design in coordination with ART, Metrobus, and regional transit providers
- Specific design concepts for slowing the speed of vehicles along Route 1
- Analysis using updated post-COVID pedestrian, bike, transit, and traffic counts, including updating Vissim models based on the new counts, analyzing potential diversion of trips from Route 1; using Vissim models to test more detailed adjustments such as leading pedestrian intervals
- Support of a potential VDOT Interchange Access Report (IAR)
- Support of VDOT's National Environmental Policy Act (NEPA) process
- Support of VDOT's procurement strategy risk assessment (e.g., Progressive Design-Build)

- Further public outreach and re-engagement with Task Force

With these tasks, the additional study will address pedestrian safety concerns raised by stakeholders and will develop a multimodal travel demand management strategy, including the development of a multimodal transfer center near the Crystal City Metro station, that aims to reduce future traffic volumes and allow convenient access to other modes of transportation.

## 8.6. Implementation Process

For the recommended concept to become a reality, as with all transportation projects, implementation must follow a deliberate process to move forward from planning to construction and culminate with a ribbon-cutting ceremony and the opening to all users. For VDOT, this process includes the following steps:

- **Project Planning:** Project identification, initial analysis, public involvement, purpose and need, and modelling.
- **Project Initiation:** Identification, prioritization, funding, incorporation into programming document (e.g., Arlington County Capital Improvement Plan [CIP], VDOT SYIP, etc.), and procurement.
- **Project Development:**
  - *Project Scoping:* Traffic analysis, concept development, initial public and stakeholder input, environmental review, and determination of feasibility.
  - *Preliminary Design:* Surveys and other field work, environmental investigations (NEPA), design to approximately 30–50-percent plans, public hearing, approved environmental document (if applicable).
  - *Public Hearing:* Meeting with the community and affected stakeholders to receive endorsement on the project from the locality and public prior to design approval.
  - *Design Approval:* Major milestone, final decision point on project delivery (Design-Bid-Build or Design-Build).
  - *Intermediate Design:* Detailed design to approximately 60–80-percent plans, initiation of right-of-way acquisition and utility relocations, final environmental (floodplain studies).
  - *Final Design:* Design to 100-percent plans, completion of construction documents, bidding, agency permitting.
- **Project Delivery:** Arlington County and VDOT permits, construction, environmental monitoring.
- **Project Close-Out:** Financial close.

The Route 1 Multimodal Improvements project is in Project Scoping of the project development process.

## 8.7. Closing

This report of VDOT's Route 1 Multimodal Improvements Study has examined the feasibility of converting Route 1 to an at-grade urban boulevard. There are currently 50,000 vehicles per day (prior to the COVID-19 pandemic) traveling along Route 1 near the existing underpasses at 15th Street S and 18th Street S, allowing the separation of these vehicles from pedestrians, bicyclists, buses, and other vehicles. This study examined the challenges with existing and future pedestrian safety, walkability, bikeability, access to transit, and traffic congestion with the evolving urban form of Crystal City. Describing the series of analyses, this report has discussed and presented the feasibility of overcoming these challenges as well as the challenges of safely removing an urban freeway while keeping people moving in the corridor by whatever mode they choose. In addition, this has been guided by the *Crystal City Sector Plan* and by the recent publications by the National Landing Business Improvement District (BID) and by Livability 22202, as well as national trends and local plans, all of which for a vision for National Landing.

Given the feedback from Task Force members and many other stakeholders, including local residents of the neighborhoods in and adjacent to Crystal City, as this report is finalized, VDOT will move into the Phase 2 of the study, with the ultimate goal of implementing solutions that will create a safe, comfortable, urban boulevard in concert with transportation improvement projects being implemented in Crystal City by Arlington County and by landowners through their redevelopment projects.

# Appendices

## **Appendix A: References**

## **Appendix B: Existing Infrastructure Conditions Technical Reports**

- B-1: Route 1 Feasibility Analysis Summary
- B-2: Route 1 Existing Geotechnical Conditions Memo
- B-3: Route 1 Conceptual Storm Drain SWM-BMP Report

## **Appendix C: Existing Conditions Summary Report**

## **Appendix D: Future No Build Conditions Summary Report**

## **Appendix E: Task Force Meeting Summaries**

- E-1 Task Force Meeting Summary, September 29, 2020
- E-2 Task Force Meeting Summary, December 7, 2020
- E-3 Task Force Meeting Summary, February 25, 2021
- E-4 Task Force Meeting Summary, June 14, 2021

## **Appendix F: Metroquest Survey Summary**

## **Appendix G: Public Information Meeting Summaries**

- G-1: PIM 1 December 16, 2020
- G-2: PIM 2 March 3, 2021
- G-3: PIM 3 June 16, 2021

## **Appendix H: Conceptual Cost Estimates**

## **Appendix I: Future Build Conditions Transportation Operations Summary**